



## **Act2.3. Defining framework for integrating learning analytics models in online and blended courses**

“Improving online and blended learning with educational data analytics”

“ILEDA”

Project No. 2021-1-BG01-KA220-HED-000031121



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## 1 Activity Description

The activity 2.3 is defined in the context of the Project Outcome 2. It consists of “defining a framework which will give guidelines on introducing innovative teaching methodologies within institutions , so that introduction of such methodologies can be systematic and sustainable. Also, the framework will include guidelines on how to include usage of learning analytics (LA) to monitor student performances, while taking into consideration ethical guidelines for the responsible inclusion of learning analytics at the institutional level.”

The activity was addressed after the definition of the 2.2 activity and deeply discussed during León Transnational project meeting (TPM) and Training Week. From this meeting it was clear that first of all it is necessary to understand the LA context of each of the involved institutions

and reflect about it. This was done through a survey to the trainees of the institutions, the results and instruments employed can be seen in the next section.

## 2 Instruments employed for the context analysis

The form employed for the surveys was published in the following link <https://forms.gle/wQREz9BkEh8i2aQY8>.

It includes in a first section general information about the surveyed persons and their Learning Analytics previous knowledge Figure 1.

After this there is a section with reflection information about Learning Analytics Figure 2. Most of the questions in this section are open and related about the experience using LA, problems and suggestions.

Finally the last section of the survey (Figure 3), addresses issues related with the LA policy of the context in which the LA is applied and what is measured and how this is done.

With this form, it is possible to know each of the participants' perspectives about LA, their previous knowledge, what has been applied and the constraints that can be linked to the institutional policies.

## GENERAL INFORMATION ABOUT YOU AND LEARNING ANALYTICS

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How familiar are you with learning analytics?

- Not familiar at all
  - Familiar
  - Very Familiar
- 

Have you previously used learning analytics in any form or shape?

- None
  - Very Little
  - Sometimes
  - Many times
  - Research and Practice
  - Research Only
- 

What country are you coming from?

- Bulgaria
  - Finland
  - Serbia
  - Spain
- 

How long have you been teaching (enter number of years)?

*Figure 1. – General Information about Learning Analytics*

## REFLECTION ABOUT LEARNING ANALYTICS

How have you been using learning analytics so far, if yes can you list all the ways you have used it?

Tu respuesta

How do you think learning analytics would have improved your teaching during the pandemic? Please mention as many ways as you can.

Tu respuesta

What were the problems that you encountered using or adopting learning analytics during teaching?

Tu respuesta

What are your suggestions to improve the usage of learning analytics in teaching?

Tu respuesta

Do you think learning analytics can pose some challenges, problems, extra effort or time?

Tu respuesta

How would you like learning analytics to help you in tracking student learning?

*Figure 2. – Reflection about Learning Analytics*

## CONTEXT AND METRICS

How is the context in which you apply the LA policy?

Tu respuesta

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Which metrics do you use? What you would aim to measure with them?

Tu respuesta

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*Figure 3. – Questions to describe the context LA policy and the metrics used by the participants*

### 3 Results

The questions to answer in the surveys are mostly open, so it is necessary to analyse and present the results to follow a qualitative approach. In this case first we present the general information and later we will follow Miles and Hubberman methodology and use a matrix presentation with the questions answers grouped by categories [1].

#### 3.1 GENERAL INFORMATION

Regarding the general information we had 24 answers from the teachers involved in the Learning, Training, Teaching (LTT) Week and other of the institutions involved in the project. In the distribution by countries, Figure 4, it is possible to see a majority of answers from Serbia and less representation from Finland that involved less people in the LTT activity. Most of the participants with more than 1 year of teaching experience and with an average of 11,79 years.

What country are you coming from?

24 responses

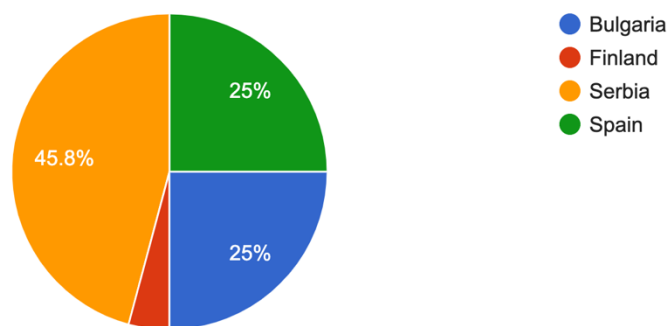


Figure 4. – Answers distribution by countries

Figure 5 shows the familiarity with LA before and only a 8,3 percent of the surveyed teachers were not familiar and most of them, almost a 92% are familiar or very familiar, which is interesting for answering the rest of the forms.

How familiar are you with learning analytics?

24 responses

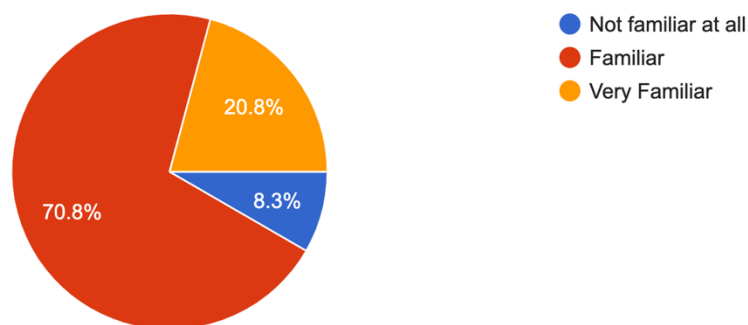


Figure 5. – Answers distribution by countries

However, familiarity with the LA concept does not mean to apply it. Figure 6 shows that most of the answers about the frequency of use show that it is used very little or sometimes: with also an important percentage for research and practice.

Have you previously used learning analytics in any form or shape?

24 responses

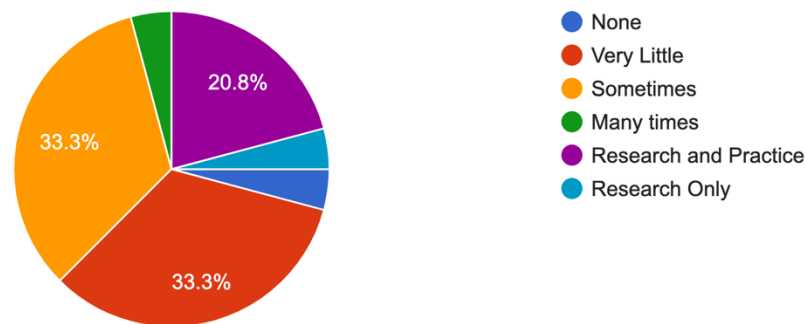


Figure 6. – Answers distribution by countries

### 3.2 REFLECTION ABOUT LEARNING ANALYTICS

In this section we will present the open answers of the participants about LA, the answers are summarized as a matrix in which we have related categories to understand what the teachers are doing, what are their expectations and problems and how LA has been applied during COVID. Table 1 shows the use of LA.

Table 1. – Uses and applications of LA

	Use of LA
P1.	Follow students’ progress, measure activity on the LMS and during the class, adapt content depending on this
P2.	I have not used
P3.	LMS Analytics
P4.	Automated assessment in programming class, forums analysis
P5.	Students’ progress on LAMS
P6.	Grades on Moodle and time on some activities
P7.	Testing methods for a PhD.
P8.	Using statistics techniques beyond educational framework
P9.	LMS and tools reports and statistics
P10.	Only for research
P11.	Statistics software during research
P12.	Evaluating students’ progress and feedback and the course content
P13.	Correlation between variables and the students success
P14.	Monitor students’ tests
P15.	LMS Analytics
P16.	Tracking students’ activities in the LMS



P17.	Interactions in forums, instant messaging tools. Also logs exploration
P18.	Students interactions in some activities outside the LMS
P19.	Students interactions
P20.	Students interactions in forums
P21.	Instant messaging tools and forums
P22.	Monitor students online work, monitor collaborative interactions, monitor teacher interactions with students. Resources use. Students progress at a global level

From the answers it is possible to see that several participants use LA to track students’ progress and engagement to try to improve their learning and to improve course contents. For other interactions with peers are important and they use both internal logs analysis as analysis for other tools. Several participants are using stats, which in some cases could be ok, especially when looking for correlations but in other cases are showing just data and not so much information. Finally, we should point out that several participants are using LA just with research aims.

Another question that is not grouped is the one related to LA application in COVID time, more specifically: “How do you think learning analytics would have improved your teaching during the pandemic? Please mention as many ways as you can.” This question, as the previous one, let us know the LA context in each institution and the participants' background related with LA. Results are shown in table 2.

Table 2. - Teaching improvement during COVID because of LA

	<b>LA during COVID</b>
P1.	Tracking students improvement
P2	Better interconnection between the videoconference tools and the LMS. Engagement in online lessons vs other activities.
P3.	Capture data outside LAMS
P4.	Explore students engagement with some activities to improve participation
P5.	Explore activity of my students in the subjects I lead.
P6.	Track students in videoconference systems and have more live feedback about students activity in the LMS
P7.	Improve classes based on students’ background or needs
P8.	Students’ presence and activity in class
P9.	Tracking students activity and resources use
P10.	Students’ progress
P11.	Track students assistance
P12.	Track students’ participation and progress
P13.	Track interactions and progress of students groups.
P14.	Improve my teaching
P15.	Improve how to work with students
P16.	Improve real participation in videoconferences
P17.	Tracking students’ performance in a more precise way
P18.	Improve my teaching and motivate them because I have monitoring tools
P19.	Check if students were doing what they were expected to do
P20.	Know what students were doing
P21.	What students were doing while programming, more information needed
P22.	Tracking collaboration
P23.	Change my classes depending on my students needs

P24.	Monitoring students’ engagement, prompting non-engaged students, alerting teachers to inactive students, help the institution to obtain a global view of the status of online learning
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COVID pandemic situation meant an important change in how classes were delivered, in fact in most of the countries they changed to online almost immediately at the beginning of the pandemic [2-6]. This means a context where LA is very important. In this case the question asks the participants about how LA would have improved their teaching. More than half of the participants understood that LA would help them to track students’ progress and, in these ways, improve their teaching, and also to address dropout problems. Also, many of them would consider it necessary to facilitate tracking not only what happens in the LMS but in the videoconference system that were so used during the pandemic.

We have grouped the next two questions in a matrix because both are related. One is about the problems about how to apply LA while teaching and the other about suggestions about how to improve it. Usually both topics are related

Table 3. – Problems and suggestions when applying LA

	<b>Problems</b>	<b>Suggestions</b>
P1.	Lack of training	More training
P2.	Lack of tools flexibility	Improve LA data and results interpretation
P3.	Know how to apply LA	Teach teachers about LA tools
P4.	Time consuming	More user friendly
P5.	-	Solving ethical problems; good samples; training
P6.	Define metrics and have information to assess them	Data in real time to make interventions
P7.	Difficulty to access to the data and data quantity	Same type of data in all the institutions
P8.	Students feeling about being tracked	Data visualization also involving students
P9.	Limited LA capacity of LMS	Possibility to combine data from different sources
P10.	-	Solving ethical problems; publicity about LA; training
P11.	Lack of knowledge about how to apply LA	Teachers’ training
P12.	Necessity of external tools to process LMS data	Improving visualization in LA reports
P13.	Define clear LA objectives	Making a strategy for applying LA with clear instruction
P14.	LMS integration with other tools	Training teachers in the LA tools provided by the LMS
P15.	Difficulty to access to data	Define proper metrics
P16.	Analyze data from different tools than institutional ones	Identify proper metrics
P17.	Lack of training	More training
P18.	Time consuming	More straightforward
P19.	Lack of support from the universities	Look for standards for more standard processes
P20.	Students needs to be involved	Teachers’ training in LA and data science
P21.	To know what to assess and how	Teachers’ training

P22.	Students feeling about being tracked	More training, involve students and more flexible tools
P23.	What to measure	Promotion of LA to teachers and institutions
P24.	Lack of proper implementation of LA, lack of comprehensive data, lack of integration of data sources, and diversity of platforms	Better system integration and teachers training improvement

Regarding these problems/suggestions topics (shown in Table 3) we should point out that the second topic is complementary to the first one so we will not repeat this in the results. Probably the most repeated problem to deal with is lack of training, it is mentioned by an important number of the surveyed. There is a necessity of teacher training about what LA means, how to apply it and the tools we have available. In addition, students and institutions should be educated in what LA means and define LA strategies that take them into account. Without this training one of the problems the participants have is that LA can be very time consuming and that they cannot properly decide what metrics they should attend to. From a technical point of view several participants claim that there is not enough information or access to it is difficult. Also, they say that LMSs do not provide tools flexible enough or reports do not properly represent the information. And it is even more difficult to deal with data from different applications that can be or not integrated in the LMS.

The last two issues explored in this section are more related with teachers' perceptions and expectations about LA:

- Do you think learning analytics can pose some challenges, problems, extra effort or time? (perceptions)
- How would you like learning analytics to help you in tracking student learning? (expectations)

Table 4, shows the answers to these questions.

Table 4. – Perceptions and expectations about LA

	<b>Perceptions</b>	<b>Expectations</b>
P1.	In terms of human factor	Interested in tracking students learning
P2.	More effort using the tools	Know what students use outside the institution
P3.	More effort at the beginning – long term value	Students' profiles and alerts
P4.	Challenge of metrics and handling big data and time consuming	Personalization and predictions
P5.	Requires time but teachers should know benefits	Analyze the students' activities in courses
P6.	If data requires processing it needs more time	Student progress, content recommendation, dropout
P7.	Time to understand how to use LA	To know the students learning key indicators
P8.	It is necessary that teachers understand LA	Students preferred contents, types, etc.
P9.	Most effort at the beginning	Tools and reports with “useful” information
P10.	Motivation to use LA	Check students' progress and allow personalization
P11.	Poor awareness of what it is LA and issues such as metrics, the tools, the access to data	What contents are better valued and what is missed in courses
P12.	Access to data beyond the institution is a challenge	Integrate data from more than one LMS

P13.	Extra effort but benefits are more important	Continuous progress and problems indicators
P14.	Long-term benefits are huge	Students’ progress and help them with problems
P15.	Difficulty to prepare and analyze data	Pay more attention to students
P16.	Automatic data processing is required	Students continuous progress and evaluation
P17.	More teachers’ working time	Accurate information about students’ performance
P18.	Extra effort to use it	Learning personalization and content adaption
P19.	It requires extra time	Personalize students learning
P20.	Requires context knowledge	Know students’ progress at different levels
P21.	Lack of training and data protection laws	More knowledge that the provided by observation
P22.	Do not choose metrics or data properly	To know what students are really doing
P23.	Deal with students’ data and institutional tools	LMS integration with other tools
P24.	Ethical, privacy, and moral challenges with dealing with data	Be more integrate

Regarding the perceptions about LA most of the surveyed participants consider that LA requires an extra effort especially at the beginning of the process. This effort is needed specially to understand what LA is and how it can be applied, to know with metrics to attend to and how to deal with the data. Institutions must have a clear policy to mitigate this extra time. Regarding the expectations, the common feeling is that LA would facilitate the real progress and performance of the students. As this would be possible also personalization would be feasible, but it would require access to evidence that is not only in the institutional environment but beyond it.

### 3.3 Context and Metrics

Regarding context and metrics, we will not use a common table because not the participants have answered. The first question is related to the context application and if there is any possible LA policy.

Table 5.- Context of application and possible policies

	<b>Context</b>
P10.	In several subjects
P11.	Research experiments and classes
P12.	In the LMS according the LMS users’ rights
P13.	In accordance with university strategy
P14.	Teachers in their classes
P15.	In accordance to rules of the university
P16.	Use it at an institutional level but know to track students progress
P17.	Depends on the institution
P18.	Focused on students
P19.	No policy, teachers decide
P20.	No clear policy, EU GDPR should be taken into account
P22.	No policy, application at any context only with data law restrictions
P23.	No restrictions beyond those of the data
P24.	Degree level

As shown in Table 5 the context of application depends on each institution, some of them could have a defined policy but this is not the most common. In any case the idea is to improve students' learning and this can be done with a very specific aim or with a long term perspective. As shown by the surveyed researchers.

Regarding the metrics it depends on different issues such as the scope of application of LA, the information available, the tools and techniques applied, etc. The metrics proposed are summarized in Table 6.

	<b>Metrics</b>
P11.	Completion rates of assignment, time spent in the course (Moodle), attendance - during synchronous online classes and in person classes, participation in discussions .
P13.	Student satisfaction, increased motivation and better knowledge
P14.	Student’s test and engagement scores to help them
P15.	The number of clicks, the time spent in the lesson, the test results
P16.	Students’ progress from logs
P17.	Logs to do predictions
P18.	Number of interactions, time employed, first messages, messages length, messages responses
P19.	Measuring students’ interactions in the CVS, number of commits, number of files uploaded, interactions, etc.
P20.	Commits, comments, updates, merges
P21.	Number of interactions, type of interactions, quality of interactions, etc
P22.	Measuring students’ interactions in the CVS, number of commits, number of files uploaded, interactions, etc.
P23.	Number of messages, discourse, libraries proximity, conversations, replies
P24.	Engagement with learning resources, interactions in online media, time spent online, regularity

## 4 The framework

Once we have checked the results of the surveyed teachers and considering the discussions of León LTT training week and TPM we could try to draft a framework for integrating learning analytics in online and blended models. This should involve both the application of learning methodologies and how to check students’ progress while applying them, so we have two main issues to address: innovative learning methodologies and learning analytics. For each of them we will consider the factors to take into account, the stakeholders involved and a tentative guide of steps to follow.

### 4.1 Innovative Methodologies

During León LTT Training Week the teachers were trained in the use of innovative agile methodologies that could be applied in their learning contexts. This type of methodologies was desirable because they use student-centered/active learning techniques to get students involved in the learning process; focus on student’s needs, abilities, interests, and learning styles; acknowledge student voice as central to the learning experience for every learner; and require students to be active, responsible participants in the learning process. During LTT the teachers worked actively on three types of methodologies: Project based Learning (PrBL), Challenge based Learning

(ChBL), and Problem based Learning (PBL). Each of them has their own features and can be applied depending on the context, so it is essential to have a clear vision of how and where these methodologies are going to be applied. Some common factors that should be clarified before applying these methodologies are some factors:

- Context. The context refers to where the methodology is going to be applied and the constraints defined by the institution. This could include:
  - Learning Modality. How teaching and training is carried out, online, blended, face to face.
  - Learning Curricula. Which educational curricula is being taught, during how many years, to what type of students.
  - Learning Management System. What kind of learning environment will be used during the educational activity, what kind of resources it provides (forums, chats, tests, teamwork tools, etc.), what kind of reports and tools can the teacher use.
  - The university active learning policy. If the context has defined an initiative to apply active learning methodologies and has promoted them or not (this would apply to the scope level).
- Application level/scope. This factor is related with the level to which the active methodology is going to be applied. Depending on it some methodologies can fit better than others. For instance, ChBL can be applied to a part of a subject, a complete subject, a course in a degree or to the complete degree. This depends in many cases on the university policy related to these methodologies and the adaptation to educational curricula. It is possible to define the methodology depending on the time available to apply it, students’ knowledge, students’ and teachers’ experience working in groups, contents and tools to use, etc.
- Data access. The data should be accessible to later possible analysis, which is related with the other part of the framework that is Learning Analytics, so it is necessary to know the data protection law that is going to be applied, what part of the students and teachers’ activities can be stored and how much of that data will be accessible for further analysis.
- Technological support. For these types of methodologies, although it is not mandatory, technology has an important impact. Beyond the LMS it is necessary to know if the institution would allow the use of other apps even if they are not the institutional ones. For instance, the institution could allow the use of Zoom institutional accounts for meetings but maybe they also allow the use of WhatsApp groups for students’ collaboration. Depending on the tools to use it is necessary to know if the information on them stored could later be available.

The stakeholders involved in the use of the methodology may be the following:

- Students. They are the core of the educational process and the centre for this type of methodologies in which they will participate actively.
- Teachers. As the leaders of the activities to be carried out and the application of this methodologies.
- Experts. Teachers and other professionals that can participate during the application of the methodologies. Not all teachers will lead the experience but many of them will participate as expert members on them. Also, external people can participate as experts, even students’ relatives.
- Educational staff. Pedagogist that can help the teachers to carry out the activity properly, sometimes they can play a double role as personal support and experts during the processes.

- People in charge. The people in charge of the institutions should know about the methodologies to be applied and ensure they are aligned with educational curricula and educational aims.

As some suggested steps to apply this methodology this framework proposes the following:

1. Describe the context in which you would like to apply the methodology.
2. Define the application level in which you are planning the action.
3. Study the scope/level to decide the best methodology to apply.
4. Set up a methodology considering the previous steps and specify the activities to carry out.
5. Identify the objectives of the application and the expected outcomes.
6. Define instruments to assess if the objectives have been achieved.
7. Define the tools to apply during the methodology application.
8. Identify the stakeholders to be involved during the process and inform them about the activity.
9. Develop a small pilot and evaluate the results.
10. Refine the activity if necessary (this involves going to step 2 or step 4).
11. Apply the methodology.
12. Assess the activity and publish the results.

## 4.2 Learning Analytics

The definition of a Learning Analytics framework is quite complicated because it depends on a huge number of factors. In this section we are going to try to describe several of them and a proposal of different steps that could be applied during the ILEDA project.

The factors to take into account:

- The context. As in the methodology section, context is going to define where LA is applied. The issues to consider in this sense are:
  - Technological systems employed. Referred to the LMS, educational tools, communication tools that are available for both the teachers and the students. Especially important in this sense is if the tools are not interconnected between them.
  - LA tools currently available for the teachers and institutions managers. Depending on the application level and technological educational ecosystem is it possible to have different tools such as dashboards, reporting tools, query tools, etc. It is very important to know what is or is not available in the context.
  - The institutional LA policy, if any. If the institution has defined a protocol to track students' progress, teachers' activities, content use and so on. If LA is going to be applied, it is good to know how the university is supporting this or if they are supporting it at all. For instance, we could have an interesting tool to exploit and present the students logs, but if the university does not allow the installation of those tools, it is something we could not apply.
- Data access policy. The data should be accessible to later possible analysis, so it is necessary to know the data protection law that is going to be applied, what part of the students' and teachers' activities can be stored and how much of that data will be accessible for further analysis, if some data must be analyzed in an anonymous way or not, etc. This policy can be defined at different levels, from the university to European laws passing through local, regional, or national laws. If external apps were used during the LA application, it is interesting to know if the data of those contexts can be analyzed from the institutional one.
- Application scope. As in the methodological part, the LA application requires to know at what level it is going to be applied, from an institutional level the learning analytics aims could not

be the same as at a course or an activity level . This could be needed for looking at other metrics or to explore metrics in order ways. For an institution it could be interesting to check the first year students pass rate, while for the first year teachers, they could be interested in how this rate is related with the hours spent in the platform.

- Metrics. Something essential in LA, once we have defined our aims and the application level is to establish which metrics we are going to attend to. This depends on the previous factors and could be related to other metrics. It is very important to understand what to assess, what information is available to do this, what tools or algorithms can we use and how we need to represent the chosen metrics.
- Ethical policy. Sometimes, it is not considered ethical to use students’ information or track what they are doing. This used to be defined at an institutional level. If some of the data could not be used because of ethical reasons this should be considered, specially at the beginning of the application of LA.
- Expert support. It is convenient to know if there is some technical team that can support the teacher in accessing the data, generating reports, or installing LA tools. In addition, it is desirable to have a team with a data science background that can help the teachers to understand or to better explore the data.

Regarding the involved stakeholders they would be:

- Students. They are the core of the educational process and ones who use to be tracked to understand how to improve their learning.
- Teachers. They used to be the ones who define what to measure and how, but sometimes their activity can be also tracked if the learning analytics is scoped on the institution management in what used to be understood as Academic Analytics.
- Technologist. Staff with a technological background that can help the teachers to access the data, to gather it, to process it or to provide reports about learning evidence. They are not always available in all the institutions.
- Educational staff. Pedagogist that can help the teachers to define which are the best metrics to attend to. They need to work together with the technologist and with the data scientist to optimize the process.
- Data scientist. Staff with data science knowledge that could help the teachers, technologist and educational staff with data analysis and representation.
- People in charge. The people in charge of the institutions could define what kind of analytics may or may not be applied depending on the institutional aims.

Possible steps to follow in the framework:

1. Describe the context in which you would like to apply the LA techniques or tools
2. Define the application level in which you are planning the action.
3. Study the scope/level to decide the best way to apply LA.
4. Make up a team involving teachers, pedagogist, technologist and digital scientists.
5. Teach your staff about LA.
6. Identify the objectives of the application of LA and the expected outcomes.
7. Define the metrics to analyse in the LA process.
8. Grant access to the information that allows exploring previous defined metrics
9. Define the tools to apply for data exploration, analysis, and representation.
10. Identify the stakeholders to be involved during the process and inform them about the activity.
11. Develop a small pilot.



12. Gather the data, pre-process it, analyse and represent if it does not show what you were looking for go to 6.
13. Apply it in a real context
14. Evaluate if LA is working properly, if not go to 6.

### 4.3. Recommendations for pilots

As during the project the way to test the research carried out is to apply the active methodologies and to develop some learning analytics approach it is necessary to take into account some issues about how to facilitate evaluation. One of the key aspects of the application of the active methodologies is not just to assess the students final outcomes but track what students are doing during the process. Tracking the progress of students with using active learning methodologies can be addressed in different ways, one of them is by designing the course in such manner so that break points are strategically placed throughout the learning materials, which allows the system to track weather the student has completed assigned activities (watched video, completed test, submitted assignment, etc.). In light of such a case, possible metrics that can be used to track student progress are: grades obtained in the activities related to the breakpoints, time devoted in each activity, clicks of resources, attempts for tests etc. In addition it would be desirable to consider the loggins information and the time of each students' session.

## 5 References

1. Miles, M.B., Huberman, A.M.: *Qualitative Data Analysis: An Expanded Sourcebook*. Sage Publications (1994)
2. García-Peñalvo, F.J., Corell, A., Abella-García, V., Grande, M.: Online assessment in higher education in the time of COVID-19. *Education in the Knowledge Society* 21, Art no. 12, (2020)
3. García-Peñalvo, F.J., Corell, A., Rivero-Ortega, R., Rodríguez-Conde, M.J., Rodríguez-García, N.: Impact of the COVID-19 on Higher Education: An Experience-Based Approach. In: García-Peñalvo, F.J. (ed.) *Information Technology Trends for a Global and Interdisciplinary Research Community*, pp. 1-18. IGI Global, Hershey, PA, USA (2021)
4. Aristovnik, A., Keržič, D., Ravšelj, D., Tomaževič, N., Umek, L.: Impacts of the COVID-19 Pandemic on Life of Higher Education Students: A Global Perspective. *Sustainability* 12, 8438 (2020)
5. Carrillo, C., Flores, M.A.: COVID-19 and teacher education: a literature review of online teaching and learning practices. *European Journal of Teacher Education* 43, 466-487 (2020)
6. Adedoyin, O.B., Soykan, E.: Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive Learning Environments* 1-13 (2020)