



Active Learning in Engineering Education

External Evaluation Final Report

ALIEN Project: Active Learning in Engineering Education

Erasmus+ Programme: 586297

Action: Capacity Building for Higher Education



**This document was prepared by
Sociedade Portuguesa de Inovação
PR-04360 | 31 March 2021**

Table of Contents

| | |
|---|----|
| 1. Introduction | 1 |
| 2. Methodology | 2 |
| Desk research | 2 |
| Phone interviews..... | 3 |
| 3.1 Relevance | 4 |
| 3.2 Efficiency | 5 |
| 3.3 Effectiveness | 7 |
| 3.4 Impact..... | 9 |
| 4. Lessons Learned | 11 |
| Annex I – List of questions for the phone interview | 13 |

1. Introduction

The External Evaluation Final Report (EEFR) was prepared by Sociedade Portuguesa de Inovação (SPI), the entity contracted to provide the external evaluation of the ALIEN (Active Learning in Engineering) project. The EEFR is a document that reflects the outcomes of the external evaluation and it was elaborated as part of the Quality Assurance and Monitoring Work Package (WP7) of ALIEN, fulfilling D7.4. The activities of building the EEFR were conducted in March 2021, following the External Evaluation Plan elaborated by SPI in July 2019 and Interim External Evaluation Report developed by SPI in September 2019. The EEFR evaluates the different aspects (outputs, activities, among others) of the ALIEN project that were undertaken from 20 September 2019 to 20 April 2021.

In addition to this introduction, the EEIR includes the following chapters:

- Chapter 2. Methodology: this chapter provides an explanation about the methodology used for conducting the external evaluation process.
- Chapter 3. Analysis: this chapter presents the analysis of the information gathered through the data collection process as part of the external evaluation, using a set of criteria.
- Chapter 4. Lessons Learned: this chapter provides findings from both interim evaluation and final evaluation. The lessons learned aim to provide important considerations for the ALIEN partners and contribute to the improvement of partners' operational performance, accountability and transparency.

2. Methodology

The EEFR was developed by analysing information gathered from desk research and a phone interview process based on the 4 criteria explained in the EEP (External Evaluation Plan), and also referred below.

Table 1. Key external evaluation criteria

| Key external evaluation criteria | Focus of evaluation |
|----------------------------------|--|
| Relevance | The consistency and validity of the project activities and outputs against the initially proposed objectives. |
| Efficiency | Measuring the resource used both from economic and time perspectives in the project activities to achieve the project objectives |
| Effectiveness | Measuring the success rate of project results and outputs against the initially proposed objectives. |
| Impact | Examination of the changes produced by the project. The changes could be positive or negative, direct or indirect, intended or unintended. |

Desk research

One of the methods used to gather the data/information for the external evaluation process was desk research. This method was based on the review of the project documentation and other accessible project outputs.

The desk research process was mainly focused on assessing documentation accessible on the Microsoft OneDrive platform used by the ALIEN partnership and other ALIEN resources (i.e. ALIEN website, ALIEN social media). The documentation assessed includes:

- D1.1 Project Plan
- D1.2 Contracts and Agreements
- D1.3 Internal Communication Platform
- D2.1 Institutional Strategy
 - Institutional strategy reports
 - State of the art reports
 - Research and methodology report
- D2.2 Specification and design of technical components
- D2.3 PBL Platform and PBL support ICT Tools
- D2.4 PBL laboratory
 - PBL laboratory presentation
 - PBL laboratory documentations (i.e. proof of payment, quotations)
 - Documentation of PBL class operation from the ALIEN website.
- D3.1 Evaluation of the Implementation Phase

- D4.1 Community Documents
- D4.2 Community Events
- D5.1 Dissemination Plan
- D5.2 Project Website, Social Networking Presence
- D5.3 Newsletter
- D5.4 Flyers and Brochures
- D5.5 Articles in Media, Conferences and Seminars
- D5.7 Alien Sustainability Plan (including Individual Lab Exploitation Plans)
- D6.1 Meeting Minutes
- D6.2 Reporting documents
- D7.1 Interim External Evaluation Report
- D7.3 Dissemination Interim Report

Phone interviews

Another data gathering method used in the evaluation was phone interviews with the representatives of the ALIEN partner organisations in order to gather important information and feedback complementing the data/information captured from the research desk method.

In March 2021 the ALIEN partner organisations were invited by email to participate in a phone interview with the external evaluation team.

In total, 13 out of the 17 partners were interviewed (3 partners did not respond to the invitation and 1 was unavailable), accounting for 10 partners from Asia and 3 partners from Europe (list of questions for the phone interview is available in Annex I). Interviews were conducted with the representatives of the project partner organisations, including the coordinating organisation based on a set of standardised questions distributed to the interviewees before the scheduled interview. The phone interviews were conducted from 15 to 31 March 2021.

Overall, the duration of the interviews was approximately 30 minutes to 45 minutes, allowing to obtain a comprehensive picture of partner perspectives about the project progress.

3. Analysis

The below analysis is structured along the key evaluation criteria as presented in Table 1 in Chapter 2. Under these criteria, the analysis is based both on desk research and the conducted phone interviews.

3.1 Relevance

Under relevance, especially the following aspects were analysed within the external evaluation:

- Alignment of the content of the project outputs produced with the initially proposed aims;
- Alignment of the content of the project outputs produced with the needs that the project aims to tackle;
- The right target groups are addressed by the project activities and outputs.

Based on the review of the available documentation and the interviews conducted, it can be concluded that the contribution of the ALIEN project to the initially foreseen objectives is high, with all major outputs being achieved and the appropriate target groups addressed. The project outputs are aligned with the initially proposed aims and objectives, and the implementation of the project clearly addressed some of the critical and structural needs of the beneficiaries. All partners participating in interviews agreed that the project activities and outputs addressed the main target groups of the project, the students and the instructors/teachers of the HEIs of the ALIEN partners.

The overall assessment is that outputs of the ALIEN project contribute to the improvement of quality of higher education among all involved partner institutions and consequently, the overall quality of educational system in partners' countries. In particular, the outputs of the project are designed and delivered to support the integration of active learning (AL) and problem-based learning (PBL) as strategic educational approaches in engineering higher education among the implementing Higher Education Institutions (HEIs), further addressing some of the critical elements required such as improved physical infrastructure among Asian partners (PBL labs), provision of digital services (collaborative digital platform), capacity building for instructors, community building and promotion of PBL and AL methods as well as the overall provision of more motivating, stimulating, and effective learning contexts based on AL and PBL that support and prepare students for professional development.

For the implementation, the partners focused their activities on two main target groups: lecturers and students. As reported in the interim evaluation, partners opted for the strategy of focusing the activities on the principal target groups (mainly teachers within specific departments) in the initial stages of the PBL methodology implementation, with plans for the expansion of activities in the second phase of the project. By focusing on a small scale, partners could deliver a quality PBL method implementation through an agile and iterative process, which could be applied towards a broader stakeholder base in the second phase of the project. While such an approach reportedly provided a number of benefits and contributed to the successful achievement of project outputs, it should be noted that due to the pandemic, some of the partners noted that a number of the departments that were planned to be targeted in the second phase, could not be reached. Nevertheless, even in such instances the partners have

already made detailed plans on how to reach the aforementioned departments, and in some cases already secured support for the implementation of the PBL method towards these departments in the post-project period.

As stated earlier, all partners reported that the project activities and outputs addressed the main target groups of the project and in many cases, the project addressed the needs of stakeholders beyond the project-defined target groups. Further, several partners emphasized that project activities allowed the main target groups to directly collaborate with partners from another continent. The target groups were reached through a different approach from partner to partner, due to the specificities in approach and local considerations for target groups. Partners that entered the project with less experience in the implementation of PBL and AL methodologies noted that more experienced partners and coordinators provided important support to the implementation activities. Moreover, some of the partners indicated that if they could restart the project, they would have had even more interactions with other partners.

It can also be concluded that the needs of teachers are well addressed by the project activities and outputs. However, with the diversity of the consortium, the same project activities meant different experiences for each of them. As suggested by the interim evaluation and confirmed by the interviews for the final evaluation, the project introduced some partners to the AL concept and PBL methodologies, while others who already had previous experience with these concepts, learned new methods and different perspectives about PBL. Some also have developed collaborations and produced publications for the project, as part of the project activities.

Many of the partners also reported a strong stakeholder engagement and positive reception of the PBL methodologies from the university management level, which represents a critical element for the sustainability of the project and more overall implementation of the AL and PBL concepts within the partner HEIs.

As a final point, partners from countries in which the PBL and AL methodologies are underrepresented in the educational system noted that the knowledge and outputs obtained from the ALIEN project were disseminated and introduced to other universities and stakeholders in the country (not directly involved in the project) successfully. According to the information from the interviews and evaluation reports, such activities generated great interest and produced very positive feedback from external stakeholders. This is further evidenced by the fact that several partners pointed out that local, regional and/or national institutions plan or are already actively supporting the continuation of partners' PBL and AL-related activities.

3.2 Efficiency

As referred beforehand, this section aims to analyze whether resources (time and financial) have been spent in the project as proposed initially. This aspect was mainly assessed through the research desk process based on the documentation available in Microsoft OneDrive platform and other accessible ALIEN resources. The interviews only touched upon resource-related aspects. Some of the findings to be highlighted are:

The planned outputs were delivered, while the overall costs of the project were within the planned budget. The overall consensus among the partners is that the benefits of the project outweigh the burden related to managing costs and the administration of the project

implementation. In terms of timeliness, the time from the approval of the project to the start of the implementation was slower compared to the initially envisaged timeline, mainly due to administrative difficulties. However, appropriate remedy measures were deployed on time and allowed for a substantial catch-up with the activities. Due to the pandemic, there was an extension to the project duration of six months, until 14 April, 2021.

From the accessible documentation, it could be observed that the financial resources spent were within the initial proposal, without exceeding the budget, with a portion of the costs (predominantly travel and stay) that have not been fully spent. In particular, the pandemic situation and globally imposed travel restrictions resulted in a portion of unspent expenditure. Based on the information from the interviews, the consortium planned that at least a portion of the unused travel funds would be repurposed for the design and delivery of an additional deliverable. Further, some of the partners pointed out that returning of the funds is undesired predominantly because the funds can be still utilized for the benefit and improvement of overall quality of project outputs. Moreover, the process for the return of funds would be procedurally demanding for some Asian partners, creating an additional burden on the partners' administration. Despite this, at the time of the conclusion of this evaluation, no approval was granted by the EC for repurposing the funds.

From the interviews and documentation, it could be noted that purchasing the PBL laboratory equipment represented the greatest proportion of the Asian partners' budget allocations. As it was highlighted during both interim and final evaluation, some partners raised concerns that more budget would be required for covering staff costs. This would particularly be necessary for the staff costs related to the implementation of the AL and PBL methods through the operationalisation of the PBL labs and the optimisation of their functionalities. These constraints are mainly due to the ERASMUS+ funding rules for the non-European partners, including the established lower staff rates for these countries, the limited proportion of the budget that can be allocated to human resources costs, as well as the rules of EC costs reimbursements.

The project documentation (timesheets) suggests that the time was used efficiently to attain the intended objectives of ALIEN, although the existing documentation does not allow drawing definitive conclusions. However, it should be noted that since some of the partners were not previously involved in ERASMUS+ projects, they did not possess a strong familiarity with the respective administrative procedures. Further, considering that the structure of educational systems in some Asian countries is different compared to the EU, obtaining the required administrative documentation to start the project took a longer time than initially foreseen. This slowed the initial implementation of the project. Some of the partners were not reluctant to begin with implementing project activities until all of the necessary administrative procedures have been completed. This situation suggests that for the preparation of future projects, the partners could further reflect on whether more time should be left for partners outside the EU to clarify and deal with administrative procedures.

3.3 Effectiveness

Under effectiveness, the following aspects were analysed within the external evaluation:

- Achievement of the results and outputs expected for this period;
- Existence of risks associated with the project implementation;
- Quality of the project coordination and management;
- Effectiveness and clarity of the communication within the partnership;
- Level of partners' understanding of the project.

Based on desk research information and phone interview responses, it can be concluded that the expected outputs were delivered and the overall implementation of the project contributed to the achievement as defined in the intervention logic of the project proposal. The interviewed partners indicated that the quality of the project coordination and management was high. Further, project documents and interviews confirm the level of partners' understanding of the project and their role. During the interim phase, several partners emphasized the need for more frequent communication within the partnership, which was addressed during the later phase of the project. In spite of challenges resulting from the pandemic situation, the majority of Asian partners have reported the ability to effectively carry out project activities and to achieve the expected outputs.

Aside from the achievement of major expected outputs, in some instances, it was observed that the results of the project were well above the initially foreseen milestones, such as the case of the number of problems/games published on the Platform. All of the 12 foreseen PBL Laboratories have been installed and are in fully operational condition. However, for some Asian partners, due to *force majeure*, PBL laboratories remain unused or underused.

In regard to the risks and challenges associated with the project implementation, the following issues were raised:

- Inability to conduct physical classes in PBLs: For the majority of Asian partners, the restrictions resulting from the pandemic situation negatively affected the implementation of physical courses in PBLs to some degree. The degree of restrictions varied from country to country, and consequently the degree of Lab usage and overall implementation of physical activities among partners as well. While some partners are currently successfully conducting classes in PBLs, others are yet to begin these activities. Further, some partners highlighted that although their institutions returned to physical classes, the size of the PBL labs is insufficient to provide necessary social distancing, and therefore PBL labs remain unused. Nevertheless, as mentioned, all laboratories have been installed and are in fully operational condition and it is only due to *force majeure* that some of the labs are underused or unused. Furthermore, the review of documentation and interviews confirmed that all partners have well-elaborated plans for the use of labs and their post-project sustainability. Therefore, this evaluation suggests that from the perspective of the project implementation, all the major results and outputs in respect to the PBL labs have been achieved.

- Conversion of physical activities (courses, community events, instructor training events) to an online format: During the interviews, several partners indicated that one of the biggest challenges during the project implementation was converting physical events to an online format, due to the pandemic situation. Moreover, the situation was further complicated by the fact that in some of the Asian partner countries access to the internet is not high and for many students and teachers, it was not easy to attend the events. On the other hand, partners noted that the application of PBL and AL methodologies proved to be significantly important for designing the overall format of courses (outside the project) and that experiences of the ALIEN project helped a smoother transition to an online format on an institutional level. Regardless of initial difficulties, all partners reported that project activities were successfully converted to an online format.
- Another notable concern, which was expressed during the interviews for the interim evaluation was the possible resistance from the main target groups of the ALIEN project, the students and the lecturers to shift to the AL / PBL methods. Most of the students are used to studying within the teacher-centered setting since most of them have used the method for more than 12 years. The adaptability is crucial both for students and teachers in this transition period. Some partners described the hesitation of the teachers at their HEIs to apply the AL method and implement PBL methodologies in their classes. This may be due to the lack of incentives, as well as the novelty of the concepts for them. They tend to not feel very confident to start the classes as they are not sure if the class will run comfortably. During the interviews for the final evaluation report, all partners reported very positive feedback from the target groups, therefore the evaluation concludes that this risk was successfully mitigated.
- During the project implementation, some of the Asian partners highlighted some hindrances in regard to the PBL implementation. This derives mainly from the limited human resources capacity (including knowledge and expertise) to apply the AL concept and implement PBL methodology-based activities in their corresponding HEIs. However, no major issue or delay was reported and as confirmed by partners, appropriate resources were always allocated for preventing any issue. Nevertheless, it should be noted that several partners reported at times overextension of human resources and the requirement for an internal reshuffling of staff for the optimized implementation.

In regards to the coordination and management of the project, partnership recognized many challenges deriving from the big consortium of 17 partners situated in 2 different continents with different backgrounds and agendas that respond to diverse local needs and concerns. This context entails different challenges to be managed and coordinated on both bureaucratic and cultural dimensions and which situation was further aggravated by the pandemic situation. However, as indicated during both interim and final evaluation, all interviewed partners expressed a positive opinion regarding the quality of project management and coordination.

Further, most interviewed partners welcomed the introduction of monthly Skype meetings, emphasizing that the communication improved in the second phase of the project. More frequent communication between partners in the partnership enabled increased cooperation

and collaboration between partners (i.e. for the implementation of the PBL pilot tests). Several partners highlighted that frequent interactions were very useful in understanding the overall progress of the project, learning about the good practices on AL and PBL from other partners, support in the installation of Labs and overall support and knowledge exchange in the implementation of the project. Further, partners indicated that email communication was efficient and that queries were answered promptly.

It was observed that most partners have a good understanding of the ALIEN project. However, it should be highlighted that in few cases, it was noted that partners are less aware of the activities and progress happening in the HEIs of other ALIEN partners

3.4 Impact

Under impact, the following aspects were analysed within the external evaluation:

- Project activities' contribution to reaching the expected impacts on the stakeholders;
- Existence of future plans to make the positive impacts of the project durable.

Based on the interview responses from the partners and available documentation, it can be concluded that the planned outcomes were achieved to a large extent and project activities contributed to reaching the expected impacts on the stakeholders. However, it should be noted that at the time of the completion of this evaluation, the results and analysis of the evaluation questionnaires that were completed by students have not been published. In terms of sustainability, both on consortium level and on individual partner level, plans and efforts to make the positive impacts of the project durable have been developed. Also, in several cases partners have already secured support for the continuation of activities related to AL and PBL methods.

By confirming the relevance of the projects' outputs with needs and aims, some partners also identified positive impacts of the performed activities and outputs, by comparing their situation before and after implementing project activities. The overall consensus among the partners is that one of the most important impacts of the project is that the project contributed to an improved cooperation among European and Asian HEIs and that, the project contributed towards the promotion, increased uptake and overall upgrade of the PBL and AL methods. As highlighted by some, the ALIEN project provided a starting point and an initial impetus for the integration and dissemination of PBL and AL methodologies, leading to an overall improvement of the quality in the curricula of the HEIs involved in the project and their alignment with the demands of the labor market. Independent of partners' previous experience with the PBL and AL methodologies, it was reported that the project enabled valuable knowledge transfer, improved cohesion among lecturers and students, insight into different good practices and for some, valuable technical equipment obtained through the installation of PBL laboratories. Further, it should be emphasized that for some of the partners, experiences and knowledge gained during the project enabled for a better design of online courses beyond the ALIEN project, leading to a smoother transition towards online teaching in the pandemic situation.

ACTIVE LEARNING IN ENGINEERING EDUCATION

EXTERNAL EVALUATION FINAL REPORT

Moreover, from the interviews and reports, it was observed that community events were well attended with a number of stakeholders that extend beyond the primary target groups. In particular, the PBL methods were disseminated and demonstrated to other universities, public institutions, researchers and other relevant stakeholders. One of the partners pointed out that their PBL Lab hosted study visits from other universities. Further, following the outbreak of the pandemic, partners reported that, although with some difficulties, they successfully converted all the planned physical events to an online format, being able to reach out to target groups. As outlined earlier in the report, for some partners, the major obstacle in reaching the target groups through the online format was the low access to internet in their country.

Based on the review of the project documentation and information from the interviews, there is a strong indication that the outputs will likely last and the outcomes and impacts, which have been achieved, will continue to have their effects in the medium and long term. All interviewed partners highlighted the importance of sustaining the outputs of the ALIEN project. Some of the partners noted that the quality of the work is at the peak and it is of utmost importance that results continue to be disseminated and applied. The interviews confirmed that the consortium has ensured that the online community platform will be hosted and maintained by one of the Asian partners for at least 5 years upon the conclusion of the project. Moreover, the coordinator has initiated the process of signing Memoranda of Understanding among the consortium members.

A review of documentation and interviews confirm that partners have successfully developed plans for integrating PBL and ABL methods into curricula. In particular, sustainability and exploitation plans suggest that most partners' future plans will be focused on the institutionalization of the AL concept and PBL methodologies. Further, partners reported that the project has generated significant interest within the management of institutions and in some cases it was reported that the management of HEIs has already made concrete plans and resource allocations for the management and operation of PBL Labs. One partner reported that their institution has concluded a partnership with a university from another country to jointly maintain and operate the Lab, while another partner confirmed plans for enabling the commercial use of the Lab in order to ensure financial sustainability. Further, several partners have reported that they have already secured external support and funding (multilateral and bilateral donors) for the continuation of PBL and AL activities. In some cases, such support was obtained by joint applications from multiple ALIEN project partners.

The information from the interviews confirmed that all partners will continue using PBL and AL methodologies. Additionally, some partners believe that the pedagogic training for teachers within the ALIEN project and their exposure to the PBL experience will be a positive and lasting impact on the institutions' human resources and suggested applying the methodology beyond HEIs and towards secondary education. It should be noted that several partners emphasized the importance of maintaining the website and PBL platform as operational, as well as ensuring the continuation of an active community.

4. Lessons Learned

A set of lessons learnt for the future implementation of similar projects have been devised based on the analysis presented in Chapter 3:

- The ALIEN consortium consisted of both partners that were well familiarized with AL and PBL concepts and partners that did not have experience with the aforementioned methods. Despite considerable the risk that gaps in knowledge within the consortium may negatively affecting the project, it was verified that this factor did not hinder the project implementation. Interestingly, more experienced partners reported about learning from the project equally to their less experienced counterparts, often pointing out the value of ALIEN's intercultural aspect. Such experience points to the value of large and geographically diverse consortia that bring together important international perspectives with more opportunities for knowledge sharing and best practice exchange, often beyond initially foreseen expectations.
- For a consortium of 17 geographically disbursed organizations, frequent communication between the partners allows partners to reflect on the overall and individual project progress, mitigate risks and discuss perspectives, experiences, challenges and best practices. For such reason, a standardized stack of tools that are regularly maintained and used can be considered crucial for boosting information exchange and building up communication between partners for the exchange of ideas. The value of good communication for the success of the ALIEN project has been highlighted by all partners with many partners particularly emphasizing the importance and benefit of monthly meetings that were introduced in the second phase of the project.
- From the interviews and documentation, it could be observed that purchasing the PBL laboratory equipment represented the greatest proportion of the Asian partners' budget allocations. As it was explained in the report, there were certain concerns in regards to the availability of human resources for successful implementation, mainly due to the ERASMUS+ funding rules for the non-European partners, particularly the established lower staff rates for these countries, the limited proportion of the budget that can be allocated to human resources costs, as well as the rules of EC costs reimbursements. Although the implementation of the project was not hindered by these concerns, this situation suggests that in future international projects, partners could further reflect on funding requirements and budget planning for organizations outside Europe taking into account ERASMUS+ funding rules.
- Since some of the partners were not previously involved in ERASMUS+ projects, they did not possess a strong familiarity with the respective administrative procedures. Further, considering that the structure of educational systems in some Asian countries is different compared to the EU, obtaining the required administrative

documentation to start the project took a longer time than initially foreseen. This slowed the initial implementation of the project. This situation suggests that for the preparation of future projects, the partners could consider reserving more time for partners outside the EU to clarify and deal with administrative procedures.

- The experience from the ALIEN project demonstrated the value that international collaboration can have for achieving high quality results with respect to AL and PBL methods. This can provide ground for further collaboration between partners in the post-project phase (i.e. possible exchange of staff for experience exchange).
- Several partners emphasized the value of the co-creative approach in the successful design and implementation of PBL and AL methods. In particular, co-creation does not only support the better identification and understanding of the needs of students and teachers but also, through engaged participation in the design and implementation of the activities, this approach boosts confidence among the end users/beneficiaries for the application of the knowledge gained and the use of lab, ensuring active engagement in the post-project phase.

Annex I – List of questions for the phone interview

- How would you assess the recent project development in the view of COVID19?
- In the context of overall implementation, have the initially expected results and outputs been achieved? Please identify any hindrances in achieving the expected objectives?
- Are there any risks associated with the project implementation? Have you applied any mitigation measures implemented for these risks?
- Do you think the quality of the project coordination and management is adequate for achieving the expected results? If not, please explain why. What can be improved to make the coordination and management more effective?
- Do you think the communication within the partnership was effective and clear? If not, please explain why. What can be done to improve the communication?
- Did you have a good understanding about the project (aims, objectives, procedures and your role in it)? If not, why? What could have been done to improve your understanding?
- Do you think the project activities and outputs address the right target groups? If not please explain why.
- Do you think the content of the project outputs produced respond to the needs that the project aims to tackle? If not, please explain why. What measures can be taken in the future in other initiatives to better align the project outputs with these needs?
- Do you think the project contributed to reaching the expected impacts on the stakeholders? How would you assess it?
- Do you have any other ideas to maximise the (post) project impact on stakeholders? If yes, what are those? How is the sustainability of the project outcomes secured?
- What would you consider as the most successful results of the project? Why?
- What would you do differently, if you could restart this the project again?
- What kind of additional support and resources (financial, technical, human resources, or other) could have been helpful to improve the provision of this project? Have the financial difficulties in the project been overcome to some extent?
- Additional comments/observations/recommendations