DIGITAL DECATHLON

WP2-c

External Evaluation of 1ˢᵗ competition

Report of 1st competition

Report of external Jury member

Report about Learning Material

Sharina Alves

Juan Camilo Olano Salinas,

Stellmacher, Dominik

JADE HOCHSCHULE
Wilhelmshaven Oldenburg Elsfleth

Karelia
ammattikorkeakoulu

UNIVERSITÀ DEGLI STUDI FIRENZE

Politechnika Warszawska

BERGISCHE UNIVERSITÄT WUPPERTAL

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Nationale Agentur für Erasmus+ Hochschulzusammenarbeit | Deutscher Akademischer Austauschdienst German Academic Exchange Service

External report

DIGITAL DECATHLON

First competition

Author:

Sharina Alves (M.Eng.), Jade University of Applied Sciences

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JADE HOCHSCHULE
Wilhelmshaven Oldenburg Elsfleth

Karelia ammattikorkeakoulu

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1 INTRODUCTION

1.1 BRIEF PROJECT PRESENTATION

Digital transformation is a top priority in the construction industry, with a focus on Building Information Modeling (BIM). Higher education institutions are adapting to these changes by introducing innovative training methods. Out of this need the Digital Decathlon project, an interdisciplinary competition aimed at architecture and engineering students, was initiated. Its primary goal is to improve collaborative digital design skills in the context of BIM.

The competition brings together students from different European countries. On the first meeting they form international teams and learn about the central design task and ten BIM-related disciplines. The collaboration takes place after returning home, decentralized and digital, and is controlled by a working platform that will demand performance and guide students through the competition phases. Learning modules will be developed and made available for self-organized learning, offering participants demand-oriented content. The competition ends at the end of one semester in a renewed meeting. Here, the results are presented and evaluated by a jury. The competition is concluded with an award ceremony and the digital exhibition of the results.

The project is carried out by five partner organizations, each of which takes thematic leadership of two disciplines, provides learning materials for this purpose, and supervises the students. Participating organizations are:

- Jade University of Applied Sciences, Oldenburg, Germany (as applicant)
- Karelia University of Applied Sciences, Joensuu, Finland
- University of Florence, Florence, Italy
- University of Wuppertal, Wuppertal, Germany
- University of Warsaw, Warsaw, Poland

1.2 EXPERTISE AND IMPARTIALITY

My expertise covers the field of Building Information Modelling (BIM) and game-based learning. My work focuses on how BIM technologies can be effectively integrated into education to strengthen students' digital competences. I place particular emphasis on interdisciplinary and

practical learning methods that are complemented by playful elements. My commitment to teaching and research aims to develop future-oriented educational formats that meet both the requirements of the modern construction industry and the EU's digital transformation goals.

Despite my affiliation with the same university as the project leaders, I assure you that my assessment of the research project is completely unbiased and objective. My commitment to scientific integrity and neutrality ensures that my assessment is based on a fair and impartial evaluation of the quality and contribution of the project. It is important to note that there are no conflicts of interest on my part. As an external reviewer, I am solely focused on making a constructive contribution to the evaluation of the project and independently assessing its scientific value. My knowledge of the university provides me with a sound insight into the institutional framework and resources, which in turn contributes to a more comprehensive assessment.

1.3   STRUCTURE AND BASIS OF THE REPORT

The following report is structured according to the work packages of the Digital Decathlon project in the chapters Project Management, Quality Management, Learning Management, Event Management and Communication. Each work package is evaluated separately. The report only refers to the first of two competitions to be held during the project period.

The basis for the preparation of the report were:

- Project documents compiled for the project application.
- Scientific publications as well as social media and website contributions on the project published to date.
- Observation protocols that I created during the central events of the project, including the event in Wuppertal, the midterm meeting and the closing event at the MED Green conference in Florence.
- Participation in internal project meetings after the start of the competition.
- Learning materials from all ten disciplines of the project.
- Evaluations of the students' final results.
- Evaluation processes and results of the three surveys of students and teachers.

2 WP01 PROJECT MANAGEMENT

2.1 OBJECTIVES

The project application identifies two main objectives for the project:

- "The project aims to jointly prepare students to operate effectively in the digital world of tomorrow."
- "The BIM digital decathlon aims to get as many students of different disciplines interested in the topic of digital design in construction as possible in order to bridge the ever-growing gap between beginners and advanced students."

Both objectives are undoubtedly being pursued by the project. It can be stated that the process formulated in the target agreement of the application corresponds one-to-one with the implemented project process. This speaks for a well thought-out and realistic planning of the project by the project management and all project partners.

Furthermore, the following sub-goals are defined, the achievement of which is measurable.

- "creation of a game environment" and "creation of learning content" both achieved
- "implementation of a total of two competitions, as curriculum-integrated events" of which the first competition is carried out
- "holding two symposia as prelude events to the competitions" of which the first symposium is carried out as a closing event
- "the organisation of two final events with jury, award ceremony and exhibition" of which the first event is carried out
- "the presentation of the training concept at conferences as a contribution to the standardisation of European BIM training" achieved - see section 6.2.6
- "the initiation of measures to continue the competition" in progress

2.2 RESEARCH INTEGRITY

As a benchmark for good scientific practice the criteria of The European Code of Conduct for Research Integrity[1] is used. The following chapters only deal with the aspects that are relevant and verifiable for this project and do not go into the actual research practice of the individual organizations in any depth.

2.2.1 RESEARCH PROCEDURES

When developing the Digital Decathlon, the project partners consider the latest state of the art in the relevant area of the BIM method and all related topics. This is ensured by the targeted contribution of expertise from the individual project partners, who each represent their own research focus.

The project partners design, analyse and document the research in a predominantly thorough and transparent manner. To this end, they work in a shared cloud in which all process steps of the project are documented and made accessible to everyone. Initially, not all partners are using the cloud equally to document their (interim) results. The partners' own procedures are regularly scrutinized by repeatedly addressing problems and potential for improvement in the surveys. The evaluation of the surveys takes place with a slight delay so that it is not possible to react directly to the suggestions.

The fact that local guidelines on BIM differed is considered. For example, the BIM execution plan is used in the learning materials, but it is not used internationally; this topic was discussed in detail in the group and solutions were developed.

From an external perspective, the research funds are used properly and conscientiously for the intended purpose, very transparent illustrated in the monthly updated Balance Sheets.

The results obtained during the project are shared among the partners in an open, honest and transparent manner and, if necessary, treated confidentially.

The project partners report on their results and methods in publications, presentations and their project website (see section 6.2). AI or similar automated tools were not used in the project from an external perspective, making a report on this unnecessary.

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[1] ALLEA (2023) The European Code of Conduct for Research Integrity – Revised Edition 2023. Berlin. DOI 10.26356/ECOC

2.2.2   SAFEGUARDS

Partners will always treat research participants with respect and consider the health, safety and welfare of the community. Similarly, the associated data collected will be handled respectfully and carefully. The protection of personal data was an important topic in the project. With the help of a privacy policy, all project participants learn which data was stored for which purpose and learned about their rights of objection. With their signature, the participants confirmed that they have taken note of this information.

2.2.3   DATA PRACTICES AND MANAGEMENT

The provision of the data as open source will only take place at the end of the project period and can therefore not yet be evaluated.

2.2.4   COLLABORATIVE WORKING

All partners take responsibility for the integrity of the research and its results. The objectives of the research and the broad process for communicating their research as transparently and openly as possible were formally agreed at the start of the project.

A formal agreement on expectations and standards regarding research integrity, applicable laws and regulations, protection of employees' intellectual property and procedures for dealing with conflicts and possible cases of misconduct has not been reached.

2.2.5   PUBLICATION, DISSEMINATION, AND AUTHORSHIP

The project partners acknowledge that the authorship itself is based on: (1) a significant contribution to the design of the research, the relevant data collection, its analysis and/or interpretation; (2) the draft and/or critical review of the publication; (3) the approval of the final publication; and (4) the agreement to be responsible for the content of the publication, unless otherwise stated in the publication. An "Author's Contribution Statement" to describe the responsibilities and contributions of each author was included in the publications where possible.

2.2.6   REVIEWING AND ASSESSMENT

Experts declare all actual or perceived conflicts of interest and withdraw from participation if necessary (see section 1.2).

2.3 PROJECT MANAGEMENT TOOLS

The following project management tools are important for the realisation of the project and serve as orientation and control for the continuation of the project.

2.3.1 MINUTES OF MEETING

The minutes of meeting serve as a structured record of discussions, decisions, and action points agreed upon during project meetings. They ensure that all partners remained informed about progress, responsibilities, and next steps. By documenting key insights and resolutions, the minutes enhance accountability and facilitate follow-ups on agreed tasks.

2.3.2 BALANCE SHEET

The balance sheet provided a financial overview of the project, summarizing assets, liabilities, and overall budget allocations. This tool helps in monitoring financial stability, ensuring cost control, and supporting decision-making regarding resource distribution. By regularly updating the balance sheet, project managers maintain transparency and adjust financial strategies as needed.

2.3.3 GANTT DIAGRAM

A Gantt diagram is used as a visual representation of the project timeline, illustrating tasks, their duration, dependencies, and deadlines. This tool enables the project manager to track progress, allocate resources efficiently, and identify potential bottlenecks. The structured overview supports effective time management and ensures that milestones are met on schedule.

2.3.4 RISK MATRIX

The risk matrix is a structured tool for identifying, assessing, and managing project risks. It categorizes risks based on their likelihood and impact, allowing the project partners to prioritize mitigation strategies. By proactively addressing potential threats, the risk matrix enhances project resilience and minimizes disruptions.

2.3.5 KANBAN BOARD

A kanban board integrates various functionalities for planning, executing, and monitoring the project. It enables collaboration, task tracking, resource allocation, and progress reporting. By centralizing project data and communications, the board improves efficiency and ensures alignment among all stakeholders.

2.4 INTERNAL COMMUNICATION

Internal communication within the project mainly takes place via email, although the learning management system Moodle was specified as the primary tool for communication. The inconsistency in the subject lines makes it difficult to identify and organize messages, which can lead to a possible impairment of efficiency and the flow of information within the project team. The problem of the increased use of emails instead of the project platform was pointed out by one project participant during the project but was not yet improved by the other project participants. However, the wording of the messages was largely understandable for all project partners and did not lead to any misunderstandings. Clear deadlines for feedback were always set in the emails. However, it is difficult to track feedback when queries are often sent in parallel by email.

The response times to messages and the adherence to deadlines for contributions to be delivered varied greatly. The binding nature of set deadlines was not understood equally by all project partners. This problem was addressed in the project group by the project management so that an improvement could be achieved within the first competition run.

Cisco Webex was initially agreed for the digital project meetings and this tool was also used throughout. Project meetings were also held in person during the events. The project meetings did not take place regularly, but always as required. The meetings were always well structured with a pre-announced agenda that all partners were able to contribute to.

3 WP02 QUALITY MANAGEMENT

3.1 OBJECTIVES

The document provided to describe the evaluation includes a detailed introduction to the project, the objectives of the evaluation, expectations, references and the evaluation criteria. Due to the delay in providing the content, it was not possible to discuss the evaluation structure in detail at the kick-off meeting, but there was an opportunity to gradually specify the criteria and expectations as the project progressed. Despite the delay, coordination within the project group was carried out retrospectively so that a common basis for the evaluation could be created.

Different overarching evaluation objectives are mentioned in various passages. These include the following

- "[…] assess methodologies, contents and formats implemented in order to understand if they addressed the initial expectations of the project partners […]"
- "[…] if the knowledge provided by the DD reaches the students, if the methods are the right ones, and which kind of skills and competences are developed by students attending the competition."
- "[…] monitor the collaboration between teachers and students and to measure the effectiveness of the project in relation to the original expectations."

Some of these objectives overlap thematically and could be more closely coordinated. In addition, reference is made in several places to the original expectations of the project partners, which serve as a benchmark for the evaluation. A more precise formulation of these expectations in the document could help to make the evaluation criteria even clearer and the evaluation more targeted.

The European Qualification Framework is appropriately used to develop the learning objectives. Accordingly, the learning objectives are divided into knowledge, skills and competencies. The learning objective in the knowledge category is: "The student has to acquire knowledge on the 10 DD disciplines". The learning objectives of the individual disciplines are only queried later, after the start of the competition, from the persons responsible for the respective disciplines. This means that they could not be coordinated in advance. It might be worth considering whether it would not be more appropriate for Learning Management to

collect the learning objectives and pass them on to Quality Management. The achievement of these learning objectives is assessed by means of tests, interviews and discussions. The informative value of some of the indicators like "number of attendance to online lessons" or "number of downloaded materials" to measure the actual effectiveness of knowledge transfer must be questioned.

The learning objective in the skills category is: "The student will be able to applying the knowledge of the 10 disciplines in a design experience (hard/soft skills)". This is assessed through the "Levels of introduction/application of the 10 disciplines' knowledge in the competition". Using the quality of the groups' actual output for the evaluation is very effective. It is important to set the focus so that not only the technical skills but also the soft skills are evaluated.

The learning objective in the competencies category is: "The students will be able to work in autonomy and responsibility valorising knowledge and skills acquired". This is a very important learning objective, but it must be noted that the measurement of target achievement goes beyond the duration of the project. Measuring long-term effects is associated with several hurdles.

The evaluation document is to be understood as a first draft for the actual evaluation. Some things were adjusted as the competition progressed. For example, the research questions that were to be answered in this first round of the competition were changed to the following:

1. How effectively does the DD promote interdisciplinary collaboration and digital skills in the field of BIM through the use of gamification and international teams?
2. What optimization strategies can be derived from the first round of the DD to make future competitions more successful?

The methods used to answer these questions are surveys of teachers and students, observation protocols and the analysis of student results. The methods are explained in more detail in the next chapter. The results obtained have been published in an open-source journal paper.[2]

[2] Calcagno, G.; Alves, S.; Grundwald, G. (2024). Assessing the Quality of an Innovative Learning Path for BIM Education: the DIGITAL DECATHLON. Journal of Civil, Construction and Environmental Engineering 9(5), pp. 143-150. https://doi.org/10.11648/j.jccee.20240905.11

3.2 EVALUATION METHODOLOGY

An iterative approach was chosen as the evaluation design. This provides for the quality of the competition to be continuously improved. To this end, three evaluation points are defined: at the beginning, halfway through and at the end of the project. The results from the surveys within the competition are to be used to continuously improve the competition during its implementation. In addition, the results will be used to calibrate the second round of the competition. Finally, a "Lessons Learned" document will be created as an output. The iterative approach is very welcome for this type of competition, as it takes place repeatedly and is very complex in terms of its content, so continuous improvement is a must. The "Lessons Learned" document makes it possible for the following interested parties not only to continue the project, but also to continuously improve it. As the "Lessons Learned" document is only produced after the second competition, it is not part of this report.

3.2.1 SURVEYS TO THE STUDENTS

In contrast to the above-mentioned learning objectives and the associated methods for determining the achievement of objectives in the first draft, the evaluation method used is a survey of students and teachers at the above-mentioned points in the competition. The survey is divided into the following sections:

- A. LEARNING QUALITY
- B. DIGITAL ENVIRONMENT
- C. BIM ADOPTION
- D. DESIGN COMPETITION
- E. COLLABORATION AND SUPPORT
- F. VALUE FOR THE FUTURE
- G. EXPAND QUALITY

In the survey at the beginning, which is addressed to the students, they are asked to assess their own knowledge. Using a rating from 1 to 5, students can indicate the disciplines in which they have strengths and weaknesses and how they rate their knowledge of the BIM method. These results provide the basis on which the improvement of knowledge is assessed in the further course. In addition, students are asked about their expectations of the competition.

In the midterm survey, students are asked about the work status of their individual disciplines and how they coped with it. To this end, they are asked to what extent the BIM introductory course was helpful and whether the task was clear and the design task was stimulating. The

extent to which communication with the teachers and within the groups worked using the tools provided is also investigated and an interim overall conclusion is requested.

In the final survey, the students are asked about the completion of their project, the distribution of tasks and collaboration between them and their satisfaction with the result. The students are asked to assess how they fared when using the BIM method and how they rate the improvement of their BIM skills. They are also asked in all areas what possible ideas for improvement they have and whether they believe they will benefit from the competition in the future.

3.2.2 SURVEYS TO THE TEACHERS

As already mentioned, teachers are asked in the survey at the beginning of the competition what learning objectives they are pursuing with their specific discipline and what criteria they want to use to check whether they have achieved their objectives. Teachers are also asked about suggestions for improvement in several areas. These results are important but can only be used in full for the second round of the competition, as fundamental changes during the competition are not conducive to an improved student experience. It is very positive that the teachers are asked how the cooperation within the project team is going, as this has a significant influence on the smooth running of the competition.

In the midterm survey, the teachers are asked how they assess their own disciplines at the halfway point and what feedback they have received from the students, especially for work in the digital environment. Here too, teachers are asked about communication between the partners and potential for improvement in several areas.

There is no final survey for the teachers.

3.2.3 JURY FOR THE EVALUATION OF THE COMPETITION RESULTS

A jury is appointed to assess the students' project work. This consists of the ten teachers who assess the teams in their respective disciplines and an external jury member who is an expert in the field of BIM.

A matrix is used for the evaluation, which was agreed in advance with all project participants. This matrix contains all disciplines per team, which in turn are subdivided into the respective subtasks of the discipline. The fulfilment of the subtasks is rated on a scale of 1 to 4 points, with 4 meaning complete fulfilment of the task. The criteria for the points awarded are described in

detail in another document. The disciplines are weighted differently. The weighting for D01 to D03 is a factor of 4, D04 to D05 a factor of 3, D06 to D09 a factor of 2 and D10 a factor of 1. The weighting of the external jury member's points is a factor of 1. The weighting is based on the difficulty of the discipline. The evaluation matrix was only created shortly before the final event, meaning that the evaluation criteria were not available to the students in advance.

Immediately following the students' presentations of the final results, the evaluation is carried out. Each teacher indicates the points for their disciplines and explains them to everyone. Teachers are given the opportunity to question the assessment.

3.3 IMPLEMENTATION

The first survey link is distributed at the end of each team's pitch in Wuppertal. This means that the students have different amounts of time to answer the questions depending on the order of the presentations. For example, the first team has a good 50 minutes until the next program item, while the last team has no time at all to answer the questions directly after the pitch. This could lead to students only completing the surveys superficially or under time pressure if the next program item follows immediately afterwards. It would be better to include a corresponding time slot for students in the program to ensure high-quality answers to the questions. The importance of the survey for the project could also be pointed out to motivate students to complete it.

The second survey link is distributed at the beginning of the midterm meeting online. The importance of evaluation is explained and a QR code is provided for students to find a survey and answer it within a week. The importance of the evaluation was addressed this time. However, there was no fixed slot for answering the questions, which could again lead to the survey being forgotten or completed superficially.

The third survey link is given out half an hour before the winners' ceremony so that students have the opportunity to complete the survey at their leisure. After the ceremony, it was pointed out again that the survey must be completed in case students were not present beforehand and what significance these surveys have for the project.

3.4 DATA EVALUATION AND REPORTING

Some of the project partners themselves do not take part in the surveys in time. The continuous improvement of the competition cannot be carried out if survey results from the first survey

only arrive shortly before the end of the competition. The participation rate of students (S1 19/25, S2 16/25, S3 18/25) is good, but there is room for improvement. This could possibly be increased by better integrating the implementation of the survey into the event process.

The analyses of the survey data are very detailed and well visualised. The evaluation shows that the questions in the survey were understandable and could be answered well and concisely. In some cases, they could be asked slightly more precisely (e.g. "Have you received any feedback from students regarding the provided learning materials?" - "positive", "negative", "none". The content of the feedback would also be interesting.).

The survey reports are regularly presented to the project partners in joint meetings and subsequently discussed. Measures are derived jointly from the survey results. These are continuously collected for the further development of the competition and improvements for the following competition are constantly discussed together.

4 WP03 LEARNING MANAGEMENT

4.1 FRAMEWORK

The task of learning management is to compile all learning materials on a common platform. There is no coordination of how the individual disciplines relate to each other. However, the initial course of the competition has shown that this would make sense so that the workload of the disciplines is reasonably comparable, and the tasks are set appropriately. Queries posed by students during introductory sessions highlight a perceived absence of structured processes within these disciplines. Students seem to lack a comprehensive map or framework that would allow them to contextualize and interconnect these disciplines. While this may foster independent exploration, it might also lead to ambiguity or disorientation among participants.

The team size of five teams of five people each proves to be suitable. The five different universities ensure a perfect mix of teams. Everyone in the team starts on an equal footing, as no one knows each other, and the division of disciplines works well. The five teams can be well separated from each other in terms of location, so that the teams do not realize what each other is working on and there is no need for too large a venue for the competition. The disciplines can also be divided up optimally (two per person) and yet each student still has the opportunity to see what their team colleagues are doing so that they can also benefit from the disciplines that they are not working on directly. In addition, good supervision by the teaching staff can be guaranteed, as a mentor is available for each team. The international composition of the teams is very beneficial, as the students automatically benefit from each other's different areas of specialization and everyone learns different knowledge and, ideally, from each other.

The increase in the total number of participants from 25 to 100 is viewed very critically by all those involved in the project. The team size of five students would no longer be possible and teams would have to be increased to ten students. In addition, the mentors would no longer be able to provide the same level of support as they do now. In order to maintain the quality of the competition, a maximum number of 50 students would at best be considered.

Students are free to choose their own software for working on the disciplines. However, as assistance is required, the students were suggested industry-standard software, for which there is a tutorial for use in each case. Complete neutrality is not possible. This was solved well for the most part.

4.2 TEACHING METHODOLOGY

The pedagogical landscape within the context of the Digital Decathlon project encompasses an array of teaching methods aimed at fostering collaborative learning experiences among multidisciplinary students. The central methods are simulation, competition and mentoring.

The strength of the simulation lies in its minimal theoretical exposition, swiftly transitioning students from brief lectures and fundamental BIM exercises to practical application. This rapid immersion into practical tasks allows students to engage more quickly with hands-on learning experiences on a real project. It allows the students to practice creating, editing, and analysing BIM models, exposing them to the complexity and challenges they would encounter in real construction projects.

The competition adds a gamification element, motivating students to actively participate, perform well, and strive for higher scores. Therefore the Digital Decathlon employs a set of clear assessment criteria to evaluate the disciplines involved. These criteria serve as fundamental guidelines for the evaluation process, ensuring consistency and objectivity in assessing student performance across disciplines. This competitive aspect fosters a sense of achievement for the students. However, attention must be paid to the fact that a competition can also become a source of frustration for the participants. Namely, when teams cannot win because some members no longer participate. Working with the dummy is not satisfactory for the students, as they can carry out their discipline but have no realistic chance of winning the competition.

Additionally, the provision of dedicated mentors for each group offers a robust support system. This personalized guidance ensures that students have readily available assistance and guidance throughout the process. This also includes an encouraging culture that embraces errors and openly communicates that students will be challenged. This transparent acknowledgment of potential difficulties normalizes problem-solving and underscores the intentional exposure of students to challenging scenarios.

4.3 OBSERVATIONS ON THE COMPETITION PROCEDURE

4.3.1 COMPREHENSIBILITY OF THE TASK

The learning objectives clearly communicated to the students are that they should learn to simplify complex issues and prioritize tasks to meet deadlines. The aim is also to provide an introduction to the BIM methodology, in the sense that the basics of the methodology should

be understood and initial practical experience in the application of BIM use cases in related disciplines should be gained.

To this end, there are clear assessment criteria for students in each discipline. Some disciplines have presented these very clearly at the beginning. The other disciplines should also be guided by these criteria and clearly set out their objectives in the initial course.

The students had no problems understanding the task after the presentation. They started the group work phases without the need for further explanations from the mentors. During the first few days, they only had questions about the scope for designing the cultural centre. By the mid-term event, it had become clear that the disciplines were standing a little too much on their own. The students lacked a kind of "map" showing where the disciplines are located and how they are connected (who must deliver what to whom and when, who communicates with whom). Questions from students show that the processes within the disciplines are not clear either. On the other hand, this "finding out" can be part of the learning process. In this case, for example, the midterm presentations must also be checked to see whether the connections have been correctly understood. In the first round, one team has already demonstrated this by creating a rough process diagram.

4.3.2 INTERPLAY BETWEEN THE DISCIPLINES

The balance of disciplines for an interdisciplinary approach must be questioned. It is noticeable in the students' presentations that they focus very strongly on discipline 1 - architecture and less on the other disciplines. It should be emphasized in the next round that all disciplines are to be treated equally and that it is about linking them and not focusing on architecture. In addition, the complexity or focus of this discipline should be adjusted so that results for the other disciplines are available quickly.

Students note that many disciplines cannot yet be carried out if the architecture model has not yet been provided. Students are very dependent on the architecture model. This reflects the reality in which other project participants are also unable to work until the corresponding model is made available to them. However, the other students do not gain any experience in their own discipline for too long. Next time, an early deadline must be set for the first architectural model to be made available to the participants.

Most groups are not properly organized. There are no schedules, some participants do nothing at all and there are no responsibilities. For the next round, the teachers suggest holding a

workshop on project management before the start of the competition so that the teams can organize themselves better and know which tools they can use to make project work easier. Due to the factors mentioned above, a workshop on project management is useful for the students and thus improves the added value of the competition for later practice.

This is one of the topics where teachers are unsure about the extent to which they should adapt the competition, as all the problems that the students have noted are exactly the same in reality and that living through these problems helps the students to prepare for them. Here it is up to the teachers to find the right balance between practical relevance and abstraction for a good flow of the game.

4.3.3   COLLABORATION AND TEAMWORK

The students rate the cooperation in the teams as difficult in some cases. There are students who no longer report to their team members, but on whom the others are dependent due to the discipline assignment. It is particularly difficult for those teams in which the student responsible for discipline 1 - Architecture does not complete their work or make it available, as all other disciplines are based on it. For these groups, a dummy was provided for the other students to continue working with. The dependence of all participants on Discipline 1 - Architecture is too great. If this discipline cannot be fulfilled, all other disciplines cannot be fulfilled as a result. Providing a dummy for further work is a good first step, but further control mechanisms should be put in place in future to help these teams at an early stage.

In addition, finding a date is difficult for some teams, as the lecture times and other commitments of all students are different. Some students would therefore like there to be mandatory joint appointments for the teams with the mentors or lecture dates with compulsory attendance. This would give the mentors a brief insight into the students' progress beyond the midterm event and allow them to intervene if necessary.

Although, as mentioned above, the D01 has a strong weighting in the competition, it has encouraged the teams to work more as a team. The groups showed very good cooperation in this discipline, especially during the time in presence. It all depends on the weighting of the project objectives: Should international and interdisciplinary teamwork be strengthened or is learning the BIM method the top priority?

At the end of their final presentations, most of the teams made it clear that, despite some difficulties, they had a lot of fun at the competition, made friends and were grateful for the

experience. The fact that the teams reported this back can be seen as a very positive sign in terms of the networking of students across national borders.

4.3.4 COMMUNICATION AND PROVISION OF INFORMATION

Over the course of the project, the students criticized the fact that the mentors gave individual groups / nationalities different or additional information than other students. The disclosure of different information to individual students results from the fact that no means of communication is used across the board for everyone. Emails are occasionally sent to students without other students or mentors being aware of this. Accordingly, a communication tool must be agreed upon in the future and who sends information to all other project participants.

Another criticism was that information is provided in too many different places. Students lack an overview of where to find what. They are overwhelmed by the multitude of platforms and software and do not know what information can be found where. Out of necessity, students have created their own overviews of where to find which information. We should build on this and provide a plan like this and check whether the multitude of platforms and software is necessary. Due to the complexity of the information, the teachers themselves suggested working in a CDE for the second round and providing a Moodle for all learning materials to use fewer different software.

The students are calling for a chat function or a FAQ section in Moodle that allows them to communicate directly with the mentors at the relevant points. Some students are also not clear who is the contact person for which things, as they have not found the information again. All students ask themselves the same questions and so the information would be clustered directly in the right place, the others would not have to ask for it themselves and the information would not be in the students' mailboxes without the others noticing anything about it.

The teachers also noticed that some students were unclear about certain disciplines until the end of the competition, but the students did not contact the respective mentor for the discipline. It is assumed that the reason for this could be that students do not always have the confidence to ask questions. The need for the possibility to ask questions anonymously is derived from this observation.

Students report problems with licenses. These have prevented them from starting with certain disciplines. It is requested that the licenses should be available before the start of the project.

The students were unable to clarify the problems with the mentors by email. The licenses should be tested at the start of the competition to ensure that the students can work. If there are still problems, this should not be clarified by email, but it should be possible to make an online appointment with the mentors at short notice to explain the problem and ultimately resolve it.

4.4 LEARNING MATERIALS

4.4.1 GENERAL

In the model provided, the objects have German names, which could lead to difficulties for international students. Some of the learning materials are also in German and it was difficult for students to switch to English in the BIM course. All learning materials should be checked again for their language.

4.4.2 BIM PRE-COURSE

The BIM pre-course, designed as an introduction to the basic concepts and tools of Building Information Modelling (BIM), is an optional part of the competition. Many students chose not to take the course or felt that it was of little value. As the introduction to the BIM methodology is particularly important for students who have not previously come into contact with BIM, the effectiveness should be increased and incentives created to encourage students to participate.

4.4.3 DISZIPLINES D01 TO D10

The learning materials of the ten disciplines are assessed by Mr Stellmacher of the University of Wuppertal and can be found in a separate report.

5 WP04 EVENT MANAGEMENT

5.1 PROJECT FLOW

5.1.1 START IN WUPPERTAL

Tuesday, 10.10.2023

The start of the competition takes place on October 10, 2023 at the LivingLab site at Mirker Straße 48 in Wuppertal. One of the buildings located there is available for the day. At 9 a.m., the first thing that happens is an introduction in the lecture room. The introduction contains all the important framework conditions for the competition as well as the task to be worked on. This involves the conversion of an old industrial hall into a cultural centre. The industrial hall does not really exist, but the site on which it stands does. During the redesign of the industrial hall, ten disciplines are to be carried out by each student team during the current semester. The student teams will compete against each other so that a winning team will be chosen at the end of the competition.

At 10 a.m. with the introductions over, students play a get-to-know game under the guidance of a research assistant to find common ground. It brings the students together from the outset and allows them to overcome differences. The immediate division into international groups breaks up national groupings and encourages students to converse in English from the outset.

This is followed at 11 a.m. by the first lecture part of two hours, where the first five disciplines are presented: D01 Architecture, D03 MEP, D04 Model Checking, D05 BIM Design Coordination and Communication, D06 Construction Sheduling. These are presented by teachers from the respective university responsible for the discipline. The presentations follow a similar pattern, first introducing the subject of the discipline, describing the tasks to be performed, and listing the documents to be submitted.

After lunch at 2 p.m., a researcher from the University of Wuppertal leads the students and teachers through three of the LivingLabs, explaining the origin of these from the Solar Decathlon project and the special features of the buildings. Afterwards, the site for the project's industrial hall, which is located right next to the LivingLabs, is inspected and questions from the students about it are answered.

The second part of the lecture starts around 3 pm. The last five disciplines are be presented: D02 Construction, D07 Life Cycle Asessment, D08 Simulation, D09 Building product traceability, D10 Reporting. In contrast to the other disciplines, the presentation of discipline 02 and 07 is digital. At 5 pm the first day of the event is over.

Wednesday, 11.10.2023

The second day on October 11, 2023, starts start at 8:30 a.m. at the University of Wuppertal, Pauluskrichstraße 7, where students and teachers are be given a tour of the laboratories of the Department of Civil Engineering. Part of the tour was the presentation of the BIMsprint project, the product traceability project and various projects with the university's own robot arm.

At 10 a.m., students can begin their work. For this purpose, each team is assigned a building of the LivingLabs to work in. The students have the opportunity to ask the teachers questions at any time. This possibility was used by all teams. During the time of the teamwork, the teachers worked out the exact evaluation criteria, the jury participants and the exact procedure for the end of the competition in Florence.

After five hours of working time and one hour lunch break, the student teams are called upon to present their first processing status in the form of a five-minute pitch. It is important that the students presented their rough concept for the industrial hall and that an allocation of the ten disciplines to the individual team members is made. Each pitch is followed by the provision of the evaluation link for the initial evaluation of the students. Thereupon the project meeting was officially closed.

5.1.2 MIDTERM PRESENTATIONS ONLINE

The teams' midterm presentations start at 10 a.m. on November 24, 2023. The event takes place online via Zoom. All students and lecturers were invited, although some students cannot or only partially participate due to overlaps with their other teaching commitments. The aim of the event is to present the results of the team's work to date in all disciplines.

At the beginning, the students are asked for each discipline and team by team what problems and difficulties they had encountered so far. Solutions to these problems are sought together with the teachers. However, positive experiences are not surveyed. The survey link is then made available, and the students are asked to complete the survey in the coming week.

Breakout rooms are then set up for each individual team, in which the teams have 15 minutes to present their project results to date to the teachers without members of the other teams. After the presentation, each teacher spoke once to give the students feedback on their progress to date and recommendations for their further work. The teams have requested that they give their presentations alone so that the other teams do not learn anything from them. In retrospect, this was not considered a good idea, as the students would not learn anything from each other. This is a good objection and should be implemented accordingly in the next competition for the midterms.

After all the teams have presented, there is a short feedback round in which each teacher gives their impressions of the presentations and makes suggestions for future improvements.

5.1.3 FINALS IN FLORENZ

Wednesday, 14.02.2024

The finals of the competition started on February 14 at 9 a.m. at the Santa Teresa building of the University of Florence. After a welcome, the students receive instructions on the following procedure. The students have the opportunity to finalize their project during the course of the day and to rehearse the presentation of the results together.

During this time, the teachers hold a project meeting to look at the initial evaluation results and an interim status of the external report to plan the next competition on this basis.

Thursday, 15.02.2024

The Mediterranean Green Forum (MGF) takes place at the University of Florence parallel to the final of the Digital Decathlon. It is an international meeting, where researchers and experts come together on the topic of the sustainable future of Mediterranean cities. Accordingly, the second day starts at 9 a.m. with a session of the forum, in which the paper "Building BIM Competence: Learning in the DIGITAL DECATHLON" is presented by the project leader. The following session is reserved for the students' results. In addition to the posters designed by the students, which are exhibited at the poster session, each group presents its project results for each discipline in 10 minutes. Combining the MGF with the finals of the Digital Decathlon is a very good opportunity to not only draw further attention on the project but for the students to gain first experiences with presenting work in an international context outside of the university.

Directly after the session, a new project meeting is held at which the jury, consisting of the teachers and an external person, evaluates the projects. The winner will then be announced at 6 p.m. in the presence of the project partners and students.

6 WP05 PUBLIC RELATION

6.1 WEBSITE

The website can be found at https://digitaldecathlon.projekt.jade-hs.de/ and presents the contents of the project to outsiders. The page is divided into the development of the vision and idea of the project, an introduction to the project partners, the competition process and FAQs about the project. For up-to-date information, there is a link to the project's Instagram account.

The usability of the website is very good. Navigation through the website is intuitive and is supported by a clear menu structure. The responsiveness of the site is given for all end devices. Only images are not optimally recognizable on smaller devices. The page loading speed is sufficient.

As the current project status is published via the Instagram account and the website only presents the basics of the project, the information is always up to date. The information provided is to the point and presented in a way that is easy to understand and appealing for external interested parties. The FAQ directly addresses and answers all possible questions about the project. The project goals, deadlines and participants are clearly defined. A contact address is available for further questions.

The website is largely accessible according to the BITV test. The following points remain open: Alternative texts for images, the ability to pause moving content, the ability to access all content without a mouse (especially the menu).

6.2 INSTAGRAM

The project is communicated very well via the Instagram channel. The Instagram account is divided into posts from the teaching team and posts from the student teams. The colour coding provides an overview despite the similar layout.

The teachers report generally on the project, project preparation, internal meetings, the competition, as well as public appearances at conferences or publications in the form of weekly updates, posts, stories, reels and reposts. Stories and reposts are recorded in the highlights.

The student teams also report on the ongoing competition, present themselves as a team and their strengths, their collaboration and the design process in the form of fortnightly updates, posts, stories and reels. Stories and reposts are recorded in the highlights. The students have a direct influence on what is published via the D10. This allows outsiders to see first-hand where the students stand during the project. The channel is a good way of getting the project idea out there and encouraging other universities to emulation.

6.3 CORPORATE IDENTITY AND LOGO

The chosen logo and the associated CI have a clear recognition value and are easy to associate with the project. With its colours, the logo reflects the diversity of the project participants, but also the diversity of the disciplines, which are all part of a larger whole. The chosen font and typography are easy to read and fit well with the style of the logo.

6.4 PRESS

27.02.2023 „Kickoff zum Digital Decathlon an der Jade Hochschule" Jade Newsroom https://newsroom.jade-hs.de/magazin/kickoff-zum-digital-decathlon-an-der-jade-hochschule

6.5 PUBLICATIONS

- Grunwald, G., Hollermann, S., Kawasaki J. (2023). BUILD DIGITAL. BUILD BETTER. The "digital Decathlon" a European Erasmus+ project, Conference Paper, 71th JSEE Annual Conference, ISSN 2189-8936, https://doi.org/10.20549/jseeen.2023.0_2
- Zeisberg, L. (2024). BIM Practice and Experience: Digital DECATHLON, in Luhmann, T., Sieberth, T. (Hrsg.): Photogrammetrie-Laserscanning-Optische 3D-Messtechnik – 21. Oldenburger 3D-Tage. Wichmann Verlag, Berlin/Offenbach, ISBN 978-3-87907-750-2
- Grunwald, G., Hollermann, S., Heins, C. (2024). BIM Game – ein digitales Rollenspiel. In Vermittlung von BIM in der Hochschullehre, 2. Auflage, Positionspapier des Arbeitskreises BIM im Baubetrieb des Fachausschusses Baubetrieb und Bauwirtschaft. https://doi.org/10.1007/978-3-658-44514-0
- Calcagno, G., Bertelli, M., Grunwald G. (2024). The Digital Decathlon: A Journey in Building Information Modelling Education. Journal of Mediterranean Cities, 4(1). https://doi.org/10.38027/mediterranean-cities_vol4no1_3%20

- Calcagno, G.; Alves, S.; Grundwald, G. (2024). Assessing the Quality of an Innovative Learning Path for BIM Education: the DIGITAL DECATHLON. Journal of Civil, Construction and Environmental Engineering 9(5), pp. 143-150. https://doi.org/10.11648/j.jccee.20240905.11
- Grunwald, G.; Alves, S.; Bertelli, Matteo; Calcagno, Gisella; Czmoch, Ireneusz; Dudzinska, Emilia; Heins, Christian; Hollermann, Sebastian; Kelm, Agnes; Kokkonen, Juuso; Laakkonen, Ossi; Matveinen, Mikko; Meins-Becker, Anica; Piotr, Bartkiewicz; Trombadore, Antonella; Zeisberg, Loreen (in publication). Building BIM Competence: Learning in the DIGITAL DECATHLON. Med Green Forum

6.6 PRESENTATIONS

The project was presented at the following events:

- Robbers, L., Grunwald, G.: Designing Rooms-for-Play as/through Digital Tools. ACSA/EAAE Teachers Conference, Educating the Cosmopolitan Architect, Reykjavik, Island, June 2023
- Grunwald, G.: BIM in Lehre und Forschung. Westfälische Hochschule, Gelsenkirchen, Germany, June 2023
- Grunwald, G.: A Virtual Wooden Construction. 2nd international Conference "Drivers for Wood Construction", Joensuu, Finland, Mai 2023
- Hollermann, S.: DIGITAL DECATHLON Projektvorstellung. Mittelstand Digital Zentrum Bau „Nachhaltigkeitsreise in die Bauwirtschaft", Jade University of Applied Sciences, Oldenburg, Germany, Mai 2023
- Grunwald, G., Hollermann, S., Heins, C., Kawasaki J.: BUILD DIGITAL. BUILD BETTER. The "digital Decathlon", European Erasmus+ project. JSEE Annual Conference, Hiroshima, Japan, September 2023
- Grunwald, G., Kawasaki, J., Hanke, T., Eidam J.: Robotic Process Automation to increase teaching efficiency in higher education. 2nd Asia Pacific Conference on Educational Research, Social Science and Humanities (APCERSSH 2023), Bangkok, Thailand, September 2023
- Zeisberg, L.: Digital Decathlon. CZEDUCON Conference, Brno, Czech Republic, 2023

- Zeisberg, L. + students: DIGITAL DECATHLON. Oldenburger BIM Tag, Jade University of Applied Sciences, Oldenburg, Germany, January 2024
- Alves S.: Ersamus+ Projekt Digital Decathlon – project presentation for Bauindustrieverband Bremen-Niedersachsen, Jade University of Applied Sciences, Oldenburg, Germany, January 2024
- Grunwald, G. et al.: Building BIM Competence across Europe: the DIGITAL DECATHLON project. Conference "Mediterranean Green Forum", Florence, Italy, February 2024
- Grunwald, G.: How to learn digital planning?. IMS Symposium, Dessau University of Applied Sciences, Dessau, Germany, September 2024
- Meins Becker A.: Digital Decathlon. buildingSMART Summit, Marrakesch, Morocco, October 2024
- Zeisberg, L.: Erasmus+ Projekt DIGITAL DECATHLON. Mittelstand Digitalzentrum BAU, Kaiserslautern, Germany, October 2024

WP2-c

Report of external Jury member

Juan Camilo Olano Salinas,

PARTICIPATING UNIVERSITIES

BERGISCHE UNIVERSITAET WUPPERTAL

BUW

JADE HOCHSCHULE	JHS
KARELIA AMMATTIKORKEA KOULU OY	KAR
POLITECHNIKA WARSZAWSKA	PWA
UNIVERSITÀ DEGLI STUDI DI FIRENZE	UFI

External Evaluator:

Juan Camilo Olano Salinas

Project & Process Evaluation:

-

GROUP 1 (GRADE 2.5):

The result revealed a lack of communication, even with an interesting architectural proposal the team didn't find a way to explain the strengths of the project nor of the process itself. The MEP development is not strong enough to fulfil the project requirements. The coordination process was weak and is clear on the result of the process.

-

GROUP 2 (GRADE 4):

Good architectural project, well explained in all the different phases of the process showing their understanding and knowledge of a digital shared/coordinated development. Strong structure project.

-

GROUP 3 (GRADE 3):

Problems in communicating the p... difficult to understand, this poor ... enlarge the lack of comprehensio... building flexibility was not aligne... some problems in the coordination process as well.

-

GROUP 4 (GRADE 3.5):

Good group results on an overall reading, even if the architectural design was not really strong, the MEP concept was the only one that thanked and proposed a project integration between systems and architecture. The team highlighted communication and coordination problems between the team members that generated delays in the digital process workflow. Good work in all the other process phases, apart from coordination.

-

GROUP 5 (GRADE 2.5):

No collaborative process at all, the usage of a "manual" model control and coordination during the process, looked like an "artisan" way of problem solving. The group didn't follow the digital path and no tools were used to solve the problem at the source (authoring/information sharing) and the process itself paid the price with a poor result. The group knew there was a problem, so they decided to hide it instead of solving it.

Florence, 15/02/2024

Juan Camilo Olano Salinas

WP2-c

Report about Learning Material

Stellmacher, Dominik

Gutachten zu den Lernmaterialien des Projekts „Digital Decathlon"

1. Projektübersicht

Das Projekt "Digital Decathlon" stellt eine ambitionierte Initiative dar, bei der Studierende aus verschiedenen internationalen Hochschulen in Kleingruppen interdisziplinäre Aufgaben bewältigten. Die Herausforderung bestand darin, Lösungsansätze für insgesamt zehn Fachdisziplinen zu erarbeiten. Dies erforderte nicht nur eine breite Wissensbasis, sondern auch die Fähigkeit zur effektiven Teamarbeit und zur Anwendung digitaler Werkzeuge.

2. Bereitstellung der Lernmaterialien auf Moodle

Die Bereitstellung der Lernmaterialien auf der Lernplattform Moodle ist ein wesentlicher Aspekt des "Digital Decathlon"-Projekts. Der Aufbau und die Strukturierung dieser Plattform verdienen besondere Anerkennung. Die Inhalte sind klar nach den zehn Fachdisziplinen gegliedert, was eine schnelle und effiziente Orientierung ermöglicht. Diese Strukturierung erleichtert den Studierenden nicht nur den Zugang zu den benötigten Materialien, sondern fördert auch eine zielgerichtete und eigenständige Auseinandersetzung mit den Lerninhalten. Die Verwendung von prägnanten Überschriften trägt zusätzlich zur Übersichtlichkeit bei und ermöglicht eine schnelle Identifikation der relevanten Materialien für die jeweiligen Aufgabenstellungen. Insgesamt kann die Präsentation der Lernmaterialien auf Moodle als benutzerfreundlich, gut organisiert und effektiv im Hinblick auf die Unterstützung der Lernprozesse bewertet werden.

3. Bewertung der Materialien und Softwarelösungen

Den Studierenden wurden diverse Lernmaterialien und Softwarelösungen zur Verfügung gestellt, die eine essentielle Rolle in der Bewältigung der gestellten Aufgaben spielten. Die Bandbreite der Materialien – von detaillierten Klickanleitungen bis hin zu umfassenden Informationen über Holzwerkstoffe – ermöglichte eine tiefgehende Auseinandersetzung mit den einzelnen Disziplinen. Besonders hervorzuheben ist die Bereitstellung von spezifischen Softwarelösungen, die den Studierenden ermöglichten, praktische Erfahrungen in der Anwendung moderner Technologien zu sammeln.

4. Analyse der Effektivität der Materialien

Die über die Moodle-Plattform bereitgestellten Materialien zeichneten sich durch ihre Vollständigkeit und umfassende Informationsdichte aus. Sie bieten den Studierenden eine solide Grundlage, um sich mit den komplexen Themenstellungen auseinanderzusetzen und trugen maßgeblich dazu bei, dass die Studierenden die gestellten Aufgaben erfolgreich bearbeiten können.

5. Kritik und Verbesserungsvorschläge

Trotz der insgesamt hohen Qualität der Lernmaterialien und Werkzeuge wurde in Fachdisziplin 5 eine wesentliche Lücke identifiziert. Die Aufgabe, eine nahtlose Zusammenarbeit und

Informationsaustausch zu gewährleisten, wurde durch die vorhandenen Tools nur unzureichend unterstützt. Insbesondere fehlte eine integrierte Common Data Environment (CDE), die für einen effizienten und sicheren Informationsaustausch unerlässlich ist. Daher wird die Integration der CDE von Dalux empfohlen, insbesondere da diese Software bereits in Fachdisziplin 9 erfolgreich eingesetzt wurde. Eine solche Erweiterung würde nicht nur die Effizienz steigern, sondern auch die Vertrautheit der Studierenden mit Dalux optimal nutzen. Die Verwendung von BIM-Collab und der BCF-Funktion erwies sich als unvollständig, um diesen Anforderungen gerecht zu werden.

6. Schlussfolgerung

Das "Digital Decathlon"-Projekt zeichnet sich durch ein hohes Maß an Interdisziplinarität und Praxisnähe aus. Die bereitgestellten Lernmaterialien und Softwarelösungen unterstützen die Studierenden effektiv, wobei die identifizierte Lücke in der Fachdisziplin 5 als Verbesserungspotential für zukünftige Projekte angesehen werden sollte. Die Integration einer umfassenden CDE-Lösung würde nicht nur die Effizienz und Qualität der Zusammenarbeit verbessern, sondern auch die digitalen Kompetenzen der Studierenden weiter fördern. Insgesamt kann das Projekt als erfolgreich und wegweisend für zukünftige Bildungsinitiativen bewertet werden.

Wuppertal, 22.01.2024

Ort, Datum

D. Stell

Unterschrift