

# Open Virtual Mobility

O3-A2.2: Matching tool service definition and  
O3-A2.3: Functional prototype of matching tool  
based on earlier released

O3-A2.1: Definite set of relevant matching criteria  
- Final -

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**Imprint:** This publication is O3-A2.2 & A2.3 of the Open Virtual Mobility Erasmus+ strategic partnership founded by the European Commission 2017 - 2020 under **2017-1-DE01-KA203-003494**, URL: <https://www.openvirtualmobility.eu/>

This technical white paper describes the functionality of the Moodle plugin mod\_groupformation based on the matching criteria discussed in O3-A2.1. Goal is to use the plugin in the Open Virtual Mobility learning hub to form groups of learners. This plugin is based on formerly released mod\_groupformation by the author and his team. It is part of Outcome O3 *Competency Directory and Matching Tool*.

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## Executive summary

Essential parts of the competencies defined as Open Virtual Mobility include inter-cultural and inter-personal competencies. Thus, for the provided learning courses (MOOCs) on level 3 peer activities are designed, for which the participants need to be put into learning groups. This is not done manually but by an optimization algorithm which is extended with a user-interface as a Moodle plugin, called mod\_groupformation.

After a brief repetition about learning group formation theory, the requirements are listed and explained which are derived from earlier documents and the transnational partner meetings. Afterwards, the functionality of the plugin is explained from a user perspective revering back to the requirements. It will be explained, why a matching criterion based on country-of-origin is currently out of scope, even though it was desired (as non-critical) by partner organizations. The functionality of the underlying GroupAL algorithm is described to make clear, why at certain deadlines the group formation needs to take place (instead of continuously adding participants to groups). Finally, the installation process and requirements for proper use of the plugin are provided. The document closes with a conclusion and outlook about next steps and a possible evaluation process.

## What are the objectives of this paper?

- goal of learning group formation and algorithmic optimization (brief repetition)
- requirement list
- functionalities described
- current state of the Moodle plugin mod\_groupformation

## Who is this paper for?

- Pedagogues and instructional designers interested in optimized learning group formation
- Researchers of computer-supported learning group formation to be introduced to mod\_groupformation features
- users of openVM learning hub to read background information about the group formation plugin used

## What topics are addressed in this paper?

Requirements, optimization algorithm, plugin installation, plugin usage in three steps, teacher perspective, learner perspective, optimization criteria used, multi-language support, Moodle cron, challenge of nominal values for optimization

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## Acknowledgements

mod\_groupformation<sup>1</sup> is an open source code release under GPL license. We acknowledge the work of all involved researchers, developers, testers, translators and end-users.

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<sup>1</sup> [https://moodle.org/plugins/mod\\_groupformation](https://moodle.org/plugins/mod_groupformation)

## 1. Aims and Scope

While the former document O3-A2.1 discussed in detail the scientific literature and relevance of optimized learning group formation, the scope of the current document is about the definition of the functionality provided to the project consortium with the plugin mod\_groupformation and how it can be used within the sub-MOOCs about open virtual mobility skills.

The text will:

- A. define and explain the requirements to the group formation plugin
- B. state the matching criteria used
- C. explain the user interface (course coordinator and learner perspective)
- D. deliver insight into the functionality of the group formation algorithm
- E. describe the installation process and requirements for the plugin to run properly

## 2. Learning group formation (brief recap)

When learning groups are formed to work together towards a solution of one or several tasks, the learning situation is designed to require a certain combination of prerequisite traits, skills or competencies to be present to successfully solve the task as a team (Dillenbourg 1999). If all prerequisites are met by one person, they might solve the task alone without any group work (Michaelsen et al. 1997). If necessary, prerequisites are missing in the group, the task might not be solvable.

Thus, the goal of optimized learning group formation is to find the best combination of learners per group that they individually can maximize their learning improvements towards the learning goal and all learners have the same quality of learning group (Konert et al. 2014).

## 3. Group formation plugin

### 3.1 Requirements definition

The state-of-the-art analysis and discussion from publication O3-A2.1 (Konert, 2018) was amended by decisions made during transnational partner meetings in Rome (31.05.2018) and Timisoara (27.09.2018). Originally, as mentioned in former document O3-A2.1, it was planned to collect written statements by each partner about the following questions (cf. Konert, 2018, p. 10): “

- A. *Which literature about relevant criteria for collaborative group work do you want to add to be considered in the project?*
- B. *Which literature or study or source about relevant criteria to be represented in groups for learning VM skills do you want to add?*
- C. *In your opinion, by which criteria should the learning groups be build for the open VM learning tasks? Please indicate for each proposal, whether the criterion should rather be heterogeneous (different) or rather similar (homogeneous) or rather something else (e.g. one of each kind) within the groups.*

*Partners are encouraged to invite external experts, like their organizations didactics center or pedagogical advisors to contribute to the discussion.”*

During the transnational partner meeting in Rome (31.05.2018) these questions were directly discussed. None of the partners saw substantial necessity to add literature (A, B). Based on the limited literature about positive effects of certain matching criteria on learning group performance, all agreed on building upon the reported findings of O3-A2.1 and use the same criteria as already set in mod\_groupformation. The discussion led as well to the amendment of requirement R7 (described below) to mix participants from different countries.

**The major requirements for the group formation plugin are:**

- R1 Moodle compatibility
- R2 Multi-language support (at least English and all partner organizations languages)
- R3 Can be restricted to build groups only with participants of a certain sub-MOOC
- R4 Flexible group size settable per group formation
- R5 Using the matching criteria conscientiousness, extraversion, team orientation, and motivation for course which were used before by mod\_groupformation
- R6 Course coordinators can set up deadlines
- R7 Additional matching criterion: country of origin (desired)

**Non-requirements (exclusions):**

- No integration of Moodle passed pre-tests as prior knowledge criteria vectors
- No group formation based on existing prior competencies in the field of openVM competency framework (defined by Output O1)
- No continuous group formation (asynchronously adding participants)

### **R1: Moodle compatibility**

The group formation tool is meant to be used for assisting in learning group creation within the MOOCs created by the partnership to enhance the update of open virtual mobility skills in Europe. As the learning hub and MOOCs are technically realized using Moodle, the group formation should be a plugin to be integrated into Moodle as an activity. Recent Moodle version updates should be supported.

### **R2: Multi-language support**

A declared goal of the partnership is to provide all resources in as many languages of the project partners as possible. While certain content-intensive parts will be provided in English only (due to heavy translation efforts needed), guidelines, user prompts etc. are envisioned to be available in multi-language. The group formation activity will provide the interface language in all of the languages provided by the MOOCs of Open Virtual Mobility (at maximum all the languages of the partner organizations). English will be the fallback default language.

### **R3: Can be restricted to build groups only with participants of certain sub-MOOCs**

As the group formation activity will be used within certain sub-MOOCs (covering e.g. level 3 of one of the competency areas of O1), it is necessary that the course coordinator in Moodle can adjust the group of participants used for creating learning groups. The set of relevant participants is either

designed by Moodle groupings and/or assignment of the relevant participants to a certain course within Moodle.

#### **R4: Flexible group size, settable per group formation**

At the date of this document release the partnership has decided to use the group formation plugin for activities on the highest (last) level of sub-MOOCs only (which is level 3). The activities for group work are expected to vary from peer assessment to discussions via forum<sup>2</sup>. Thus it is desirable that the group formation plugin will allow a flexible setting of a maximum group size per instance, e.g. forming groups of two (2) for mutual feedback or forming groups of 5 for discussions.

#### **R5: Using the matching criteria *conscientiousness, extraversion, team orientation, and motivation for course* which were used before by mod\_groupformation**

During transnational partner meeting in Rome (31.05.2018) all partners agreed that for group formation the formerly investigated and effective criteria, as used by mod\_groupformation in other contexts, should be used for group formation within the open virtual mobility scenario, too. While it would have been technically possible to implement different questionnaires for other personality-related matching criteria or solely rely on matching based on the competency areas defined in O1, the uncertainty how well this might work and how much individual learners then profit from their group lead to decline such changes. (Note: R7 adds one more criterion)

#### **R6: Course coordinators can set up deadlines**

While participants take the self-learning activities of the sub-MOOCs at their own pace and starting times, it is a needed requirement (based on mod\_groupformation) that from the set of learners at a certain time learning groups are formed. Thus, for the activity “learning group formation” offered by the plugin here, deadlines need to be available about when the activity opens for filling the questionnaires and when it closed because course coordinators will create groups. These deadlines will allow creation of several activities in parallel where participants can choose for which start date of group work they want to fill out the questionnaire. Manual work by course coordinators is acceptable to create new instances of the activity and/or start the algorithmic creation of groups based on the participant’s answers.

#### **R7: Additional matching criterion: country of origin (desired)**

During transnational partner meeting in Timisoara (27.09.2018) the possible integration of the matching tool was discussed. As the competency areas (O1), covered by open virtual mobility, were defined it became clear that for some areas, e.g. intercultural skills and attitude, it would be beneficial to match learners in one group from different cultural backgrounds. It was decided to achieve this by using the country of origin as an additional criterion (to be matched heterogeneously within a group). This request causes a major change in the interface and algorithm as it is a set of nominal values to be used for group formation. Currently all criteria used are interval scales. For nominal scales a drop-down list needs to be presented and the calculation of the quality of matching needs to be extended. Thus, this requirement seems out of scope of the possibilities

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<sup>2</sup> Currently the independent sub-MOOCs activities and assessment activities are not fully designed and subject to change



funded by the Erasmus+ project. Still it remains here, as it might be possible to integrate it before the end of the project using additional (financial and supportive ) resources.

### 3.2 Process of application in three (3) steps

The group formation is synchronous, thus collects data of all participants, which should be matched, and then, at a certain date, from this set of participants the groups are formed. From setup through data collection until final group formation there are three steps, described here and illustrated in Figure 1.

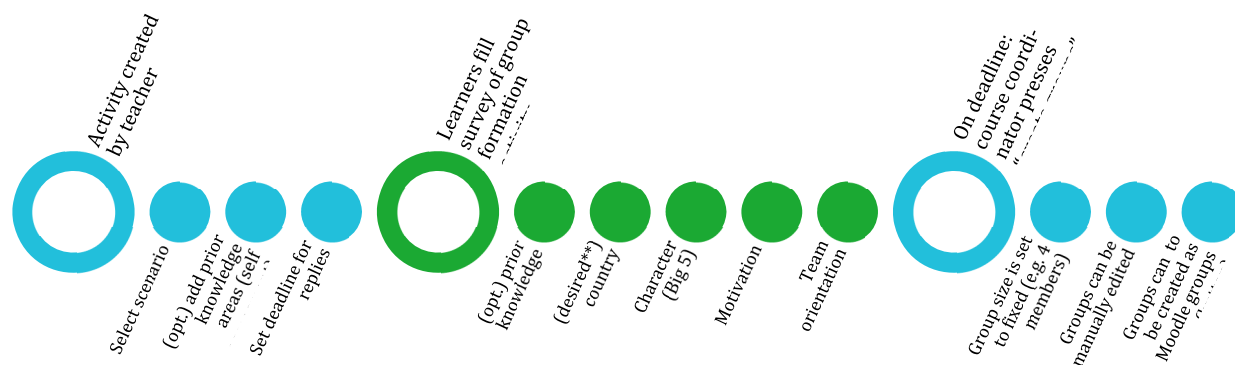


Figure 1: three phases of using group formation, \*\* the drop-down for country selection is a major extension of the algorithm and frontend presented to users and thus not implemented in the prototype currently.

**First step** is a setup by a course coordinator, who adds the activity to the Moodle course. The plugin supports three different scenarios which influence the way each criterion is respected in the group formation algorithm (more details later in this document). The activity can be restricted to be available from and until a certain date (R6). Additionally, the access can be restricted to a certain group and grouping of Moodle, in case not all participants of the Moodle course should be used for group formation (R3). Likewise, a setting is offered to consider only those participants, which answered at least one question of the group formation questionnaire. This helps to avoid grouping of participants that are in-active in the course.

**Second step** is the availability to participants (i.e. the learners), who are guided through the questionnaires, which are as well responsively designed to be usable on smartphone and desktop resolution. Participants can skip single questions, return later and finally submit the questionnaire.

**Third step** is the deactivation of the questionnaire availability, either by the set date or manually by a course coordinator. The group formation is not started automatically but needs a click on 'start group formation' by a course coordinator. This is necessary as in teaching situations sometimes deadlines are extended, or settings are adjusted, before groups are built. The calculated groups are presented after 1-5 minutes runtime to the course coordinator. A drag & drop interface allows manual correction of the group memberships before the groups are either dropped (to be re-calculated) or transferred into Moodle groups.

A more detailed description with screenshots is provided in Attachment *A1 Detailed description of the plugin usage*.

### 3.3 Final set of criteria

As described in section 3.1 Requirements definition the consortium decided to use the criteria set, found as as relevant for better group performance before in scientific literature. Additionally, the questionnaires for personality traits (Big5), team orientation and motivation can be considered as culturally stable to a certain degree (R5). Especially the Big5 are widely accepted internationally and have been translated and evaluated for reliability. As listed in Table 1 the desired additional criterion of country-of-origin has been added to the set of criteria ideally used for the open virtual mobility group formation (R7). The current version of the plugin does not support this criterion as explained in section 3.1 Requirements definition.

Table 1: list of criteria used for openVM learning group matching

Criterion	Scale	Optimization goal	Data source
<b>extraversion</b>	Interval	heterogeneous	questionnaire (big 5 items)
<b>conscientiousness</b>	Interval	heterogeneous	questionnaire (big 5 items)
<b>Team orientation</b>	Interval	homogeneous	questionnaire
<b>Motivation for course</b>	Interval	homogeneous	questionnaire
<b>cultural background/country of origin (optional)</b>	Nominal	Diverse set of values	List of countries

### 3.4 Multi-language support

While the requirement for Moodle support (R1) is given by the fact that the group formation is implemented as a Moodle plugin, the requirement (R2) for multi-language support is respected in the design of the plugin, too. The presented questionnaires to participants (character, team orientation, motivation) are stored in XML-files delivered with the plugin. Currently these questionnaire items are shipped in English and German. Likewise, the web frontend interface texts of the plugin are stored in Moodle language files which are automatically switched by the selected language of the Moodle user. Currently English and German are available. Default is set to English in case a user has selected a different language.

It is planned to provide all partner organizations with sheets of all text items (questionnaires and frontend) in English to translate them to their native language for usage. If possible existing translations for the questionnaires are used from scientific literature. The translation is planned to be done after pilot phase (end of 2019).

### 3.6 Group formation algorithm (brief summary)

After data collection there are for each participant and each question asked the answers stored in the database. For the questionnaires of character traits, motivation and team orientation the items are summed up into one value each (one for characteristic conscientiousness, one for extraversion, one for motivation, one for team orientation). These values are normalized to the interval [0,1]. Thus, for each criterion the vector value has only one dimension (the one value).

The algorithm itself supports for each criterion a weight and a type. Weight is set for all equally. Type is either heterogeneous or homogeneous depending on whether it should be as similar as possible between group members or different (cf. Table 1).

From the underlying GroupAL algorithm (Konert, Burlak & Steinmetz 2014) the group-centric matcher strategy is used. For the desired group size, the number of final groups is calculated based on the number of participants (e.g. groups of 3 from 24 participants results in 8 groups). For each empty group a pivot element is selected. Then for each group the next best fitting participant is added until the group reaches its maximum number of participants.

The next best fitting participant is decided by pairwise comparison with each member of the intermediate group. Each pairwise comparison calculates how similar the two participants are for criteria, which should be homogeneous. The smaller the distance value, the better the pair fits. For heterogeneous criteria the distance should be maximized. Here Manhattan distance metric is used instead of Euclidean as Manhattan delivers for multi-dimensional criteria more intuitive distance values<sup>3</sup>. For the one-dimensional criteria vectors in the context of open virtual mobility this is irrelevant. The mean value of all pairwise calculated fitting of the intermediate group with the possible next candidate is then divided by the standard deviation of all these pairwise fittings. This is necessary to lower the suitability for next participants that are only suitable with some of the existing group members and with some others are extremely unsuitable. Such a situation would lead to low group coherence. The participant with the highest remaining fitness value will be added to the group.

The set of groups is then returned to the Moodle plugin instance and can be revised by the course coordinator.

## 4 Installation and technical setup by administrators

The plugin can be installed by either retrieval from the plugin repository of Moodle or by manual ZIP upload of the whole plugin data. Moodle then prompts for installation in next login of a Moodle administrator account. Screenshots are provided in attachment *A2 Details about plugin installation*. For the plugin to work properly the Moodle cron needs to be set up correctly<sup>4</sup>. The group formation is a calculation intensive process and thus done in an extra PHP process by Moodle cron. Depending on the interval of cron job starting, the results are available within 1 to 15 minutes (usually Moodle cron starts each minute).

The plugin has system wide settings which can be edited by administrators.

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<sup>3</sup> E.g. for vectors (1,0) and (0,1) the distance in Manhattan is 2, but in Euclidean is  $\sqrt{2}$ . For Vectors (0.5, 0) and (0, 0.5) compared to (1,1) and (1,0) the distance should be the same, but is for Euclidean  $\sqrt{0.5}$  and  $\sqrt{1}$ . For Manhattan in both cases the distance is 1.

<sup>4</sup> Cf. <https://docs.moodle.org/36/de/Cron-Job>, last accessed 01.03.2019

The number of days can be set after which automatically all personal data (answers to questionnaires for group formation) are deleted (default is 365 days). If the plugin data is used for scientific evaluation studies the participants can be asked for a participant code in the opt-in dialog presented on first click to the group formation activity in Moodle (default is set empty). This participant code is then added to the export/download of the formation data. See Attachment A2 *Details about plugin installation* for details.

The repository of the current master code state is available on Github (see Figure 2) [https://github.com/openVirtualMobility/moodle-mod\\_groupformation](https://github.com/openVirtualMobility/moodle-mod_groupformation)

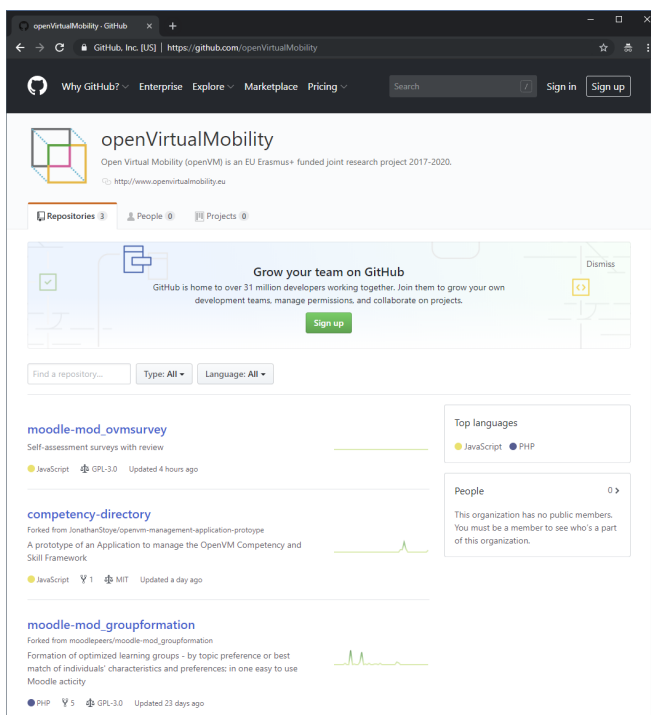


Figure 2: Screenshot of Github repositories of Open Virtual Mobility organization..

## 5. Conclusion and outlook

The document presented the Moodle plugin for group formation to be used in the MOOCs of the Open Virtual Mobility platform. At date of document release, it is not clear, in which activities exactly the learners are engaged (and in which sub-MOOCs). The plugin provides the flexibility to be setup in several instances and only match a certain subset of participants (e.g. only those belonging to a certain grouping in Moodle). Likewise, desired group size is changeable per instance. The plugin currently provides the questionnaires in English and German. More languages are expected to be added based on translations provided by the partner organizations of the project. The plugin is currently installed and running. Criteria used for group formation are the same as used in original mod\_groupformation plugin. This has been decided after literature review and discussions during transnational partner meetings. One additional criterion was desired by project

partners (as non-essential but nice to have), which is the heterogeneous criterion of country-of-origin. Based on this, intercultural mixture within a group could be optimized. Unfortunately, the current interface provides flexible configuration of prior knowledge (self-assessment) but is not suitable for the drop-down question of nominal values (here: countries as a list). Additionally, the fitness value calculation of the participants per group needs adjustments, because nominal values need to be respected in similarity/distance calculation differently than interval scales (which are all the other criteria).

In summary, the plugin is ready to be used in the sub-MOOCs of the open virtual mobility courses. The partnership decided to add group/peer activities on level 3 courses where the participants need to fill the group formation questionnaires for certain deadline dates and then the group activity will start (e.g. for 2 days or 1 week). This scenario suits the three-step process of the plugin, where after setup by course coordinators (with deadlines), participants can provide their answers to the questionnaires, and finally as a last step a course coordinator creates groups based on the provided data.

If further funding from other sources allows, the desired criterion of country-of-origin will be added in a later version of the plugin.

Depending on the integration into sub-MOOCs which is expected to be finished in Q1/2019, the plugin effectiveness could be evaluated. Such an evaluation would allow participants to voluntarily answer survey questions about their satisfaction with group members, group cohesion, and group work results. As some groups are built on random participant assignment (due to missing or not-provided questionnaire answers) the survey values can be compared A/B between optimized and randomized groups. The approach to evaluation will be further designed and discussed within the partnership and is expected to be decided until end of 2019.

The final set of functionalities will be reported with document *O3-A1.5: Final prototype and report* including the findings from evaluation, if conducted.

## 7. References

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<https://www.openvirtualmobility.eu/topics/outputs> , date of access: 01.03.2019

Michaelsen, L. K., Fink, L. D., & Knight, A. (1997). Designing Effective Group Activities : Lessons for Classroom Teaching and Faculty Development. To Improve the Academy, 385, 373–397.

## Attachments

### A1 Detailed description of the plugin usage

#### Step 1: Setup (course coordinator view)

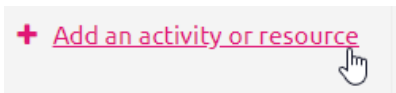


Figure 3: In the Moodle course a plugin instance can be added as activity

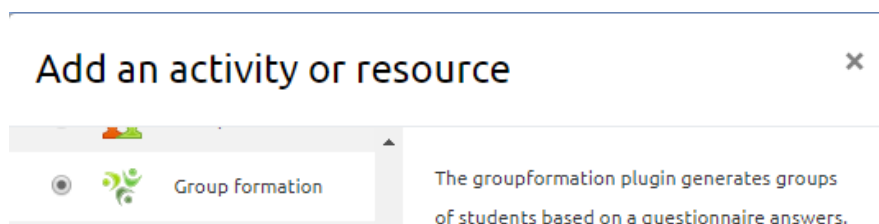


Figure 4: Select the group formation from the list

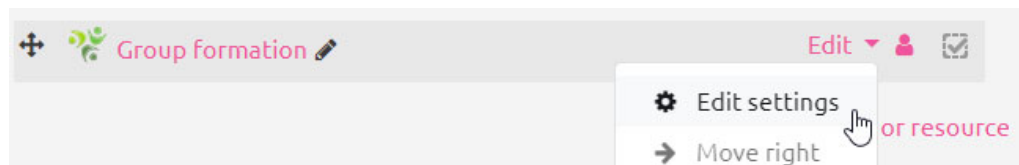


Figure 5: On creation you are directly forwarded to settings. Lateron, open settings via the Edit-menu

General

Group formation

Description

Group formation

↓

i ▼

B

I

≡

≡

🔗

🔗

🖼️

📄

🎤

📺

📎

Please fill out the questionnaire here to be added to learning groups on second course week by a course coordinator.

Figure 6: Settings - the Title is displayed directly in the course. Description is displayed to participants when they clicked the group formation activity. Thus, make sure the title explains what it is (e.g. questionnaire for homework groups or like here "group formation")

Availability

Allow answers from

6

March

2019

12

13

📅

Enable

Allow answers to

6

March

2019

12

13

📅

Enable

Figure 7: Setup - Availability is displayed to participants and allows you to enforce a deadline for group formation questionnaire to be filled. A start date is good in case you want to adjust settings and explain first during class (not applicable for openVM)

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Open Virtual Mobility, Output 3-A2 Milestone 2&3, date 15.03.2019

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## ▼ Group formation settings

How does the group formation activity work?

Please choose the most suitable scenario for the group formation. \*

### Project teams

#### Questionnaire-Usage

Knowledge areas and motivation are heterogeneous; knowledge level, targeted goals, and team orientation are homogeneous; character traits are partially homogeneous, partially heterogeneous.

Project teams work intensively together to finish a project (e.g. conduct a study, delivery of a report, etc.). Often, duties and tasks can be split among the team members. Consequently it is beneficial to have a mixture of amending competencies in the team. Usually, such a collective work result is graded with a equal group mark for all members. Thus, group formation aims for similar motivation and similar objectives (beside the prerequisites).

### Homework groups

#### Questionnaire-Usage

Knowledge areas and targeted goals are heterogeneous; team orientation homogeneous.

Homework groups complete (smaller) assignments in regular intervals (often weekly) as a preparation for examination. Even though the assignment tasks (often called exercises, practice, control questions or homework) are principally subdividable among group members, this is not intended as with the final examination each member will be graded individually and needs to be able to solve all tasks alone. Consequently, group formation aims for diverse prior knowledge and diverse learning styles that benefit from each other.

### Presentation groups


#### Students set preferences

Enables exclusively to order a list of topics by Drag&Drop. "first-come, first-served" procedure is avoided to allow a fairer topic distribution.

Presentation groups work together for a relatively short time period to finish a presentation (usually to be held in class). Often in the beginning a specific sub-task is assigned to (or selected by) each student, individually worked on, and in the end re-assembled to a complete presentation. Grading is usually done for the performance of the whole group together. Therefore, group formation aims primarily for mutual interest in the same topic.

Figure 8: Setup - the scenario selected influences the length of questionnaire and the optimization algorithm. The text explains it nicely. You need to select one scenario.

☐ I want to include knowledge questions (optional) 

☐ I want to define topics (optional) 

Group settings description \* 

0 Students are enrolled in this course

☒ Max. number of group members

☐ Max. number of groups

Figure 9: Setup - You can either set a group size or a number of groups.



☒ I want to include knowledge questions *(optional)* ⓘ

Please list knowledge areas in which students should assess themselves. Take a look at the preview on the right hand side. According to your selection "homework groups" prior knowledge will be varied within each group.

**Input:**

x

x

x

**Preview:**

How much do you know about the following topics?	0 = no knowledge, 100 = big knowledge
intercultural teamwork	0  100
project management	0  100
Example 3	0  100

Figure 10: Setup - in case you included prior knowledge areas, a preview is provided of the presented extra questions to participants (sliders). Be aware that these knowledge fields are not translated on display. (This functionality is not used in openVM setup)

☒ I want to define topics *(optional)* ⓘ

Please list topics for the students to choose from. **Then group formation optimizes using the topic selection preferences exclusively.** All other questionnaire parts will be ignored.

**Input:**

x

x

x

x

**Preview:**

Please sort the following topics regarding your personal interests and start with your favorite topic. Sort via drag and drop.

↑ The butterfly effect
↑ Moore's law
↑ Open Virtual Mobility
↑

Figure 11: Setup - for scenario presentation groups this is preselected. If topics are set, the algorithm only optimizes distribution of participants based on selected preferences. No other questions are shown to them. A preview is given (see right side). (This functionality is not used in openVM setup)

**Group settings description** \* ⓘ

You have chosen to define topics. Therefore the number of groups and their size will be calculated, as you can see below.

0 Students are enrolled in this course

☐ Max. number of group members 
☒ Max. number of groups

Figure 12: Setup - if topics are given to participants to select their preferences (for assignments), the number of groups is set automatically accordingly.

**How do you evaluate the work?** \*

☒ Only students with at least one submitted answer should be considered for building groups.  
(optional) ⓘ

☐ All questions need to be answered in order to complete the activity.  
(optional) ⓘ

Figure 13: Setup - As grading method you can select no grading, only pass, marks (1.0 to 5.0) or points (which allows you to set the max. number of points). If set, participants are asked for their grading goals and this parameter is included as homogeneous criterion for matching.

Checkbox for 'only students with at least one submitted answer' is important if you might have inactive course-members and do not want to add these to groups. Alternatively (or additionally) restrict the group formation to a Moodle grouping with only committed participants (see below later).

Checkbox for all questions need to be answered is useful if you strongly depend on optimized groupings. As all participants with incomplete questionnaire data are matched randomly among them into groups and only participants with complete data are optimized into groups, this setting might lead to more complete data sets, but can be annoying as participants cannot proceed, if one answer is missing. (For openVM MOOCs the settings are recommended as displayed)

Grouping name *(optional)* ⓘ

homework

Figure 14: Setup - a prefix name can be added which is used for the Moodle group names later on.

▼ Common module settings

Availability ⓘ Show on course page ⇅

ID number ⓘ

Group mode ⓘ No groups ⇅

Grouping ⓘ None ⇅

Add group/grouping access restriction

Figure 15: Setup - common settings allow you to restrict the group formation to a Moodle grouping (subset of your participants). If not set (as here) all participants are used for grouping (maybe without the ones that have not given any answer to the questionnaire)

▼ Common module settings

Availability ⓘ Show on course page ⇅

ID number ⓘ


Group mode ⓘ Separate groups ⇅


Grouping ⓘ GroupingWeek1 ⇅


Add group/grouping access restriction


Figure 16: Setup - if a restriction is set to separate groups and a Grouping (e.g. GroupingWeek1) within the grouping there needs to be **one group** (name is irrelevant) with all the participants to consider for group formation. This way you can even offer several group formation activities in one course which respect different sub-sets (groupings) of all enrolled participants.

▼ **Common module settings**

Availability  Show on course page

ID number 

Group mode  Separate groups

Grouping  GroupingWeek1

**Add group/grouping access restriction**

▼ **Restrict access**

Access restrictions


Student must match the following

Grouping GroupingWeek1

**Add restriction...**

Figure 17: Setup - if group mode is set to separate groups with the grouping (here GroupWeek1) it could be useful to add a corresponding access restriction (click the button) that only the participants of that grouping can see/access the activity.

▼ **Activity completion**

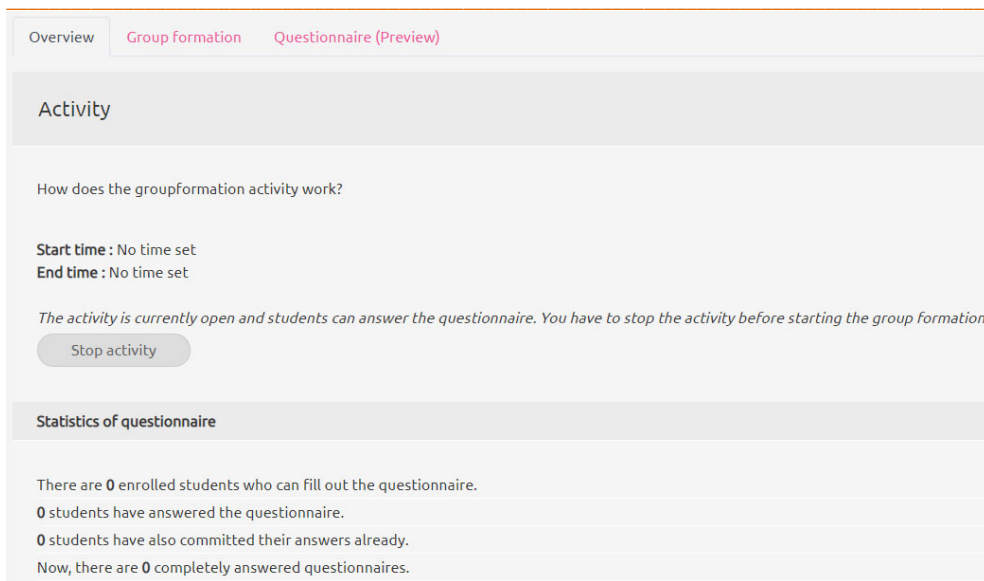
Completion tracking  Show activity as complete when conditions are met

Require view ☒ Student must view this activity to complete it

Figure 18: Setup - if you use activity control in your course, you can set the require view checkbox. The naming is Moodle default and misleading. Precisely, the group formation activity is marked complete for participants, if they filled and submitted the questionnaire of the activity.

**Save and return to course** **Save and display** **Cancel**

Figure 19: Setup - finally save the settings



Overview   Group formation   Questionnaire (Preview)

### Activity

How does the groupformation activity work?

**Start time :** No time set  
**End time :** No time set

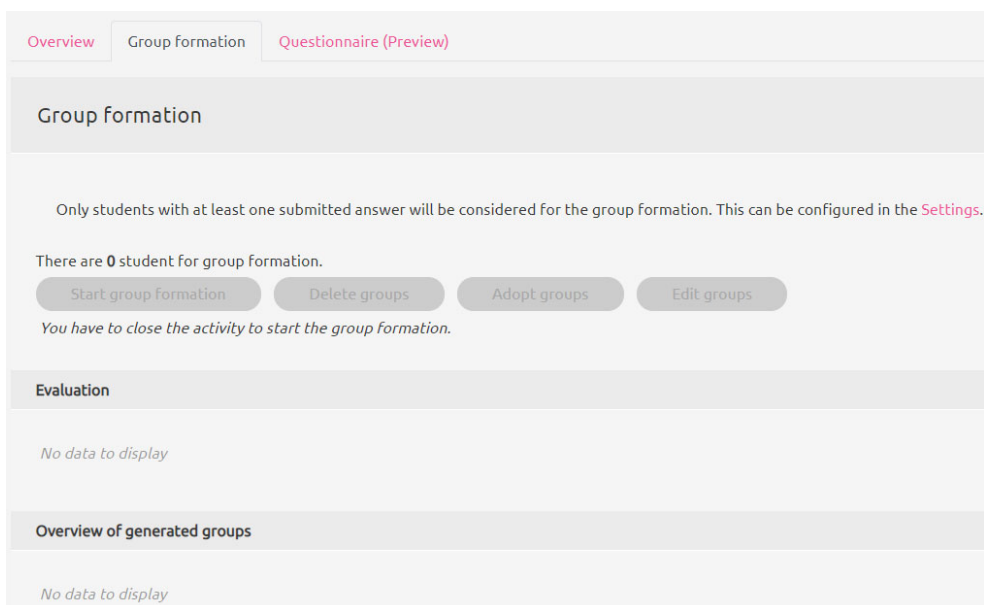
*The activity is currently open and students can answer the questionnaire. You have to stop the activity before starting the group formation.*

Stop activity

#### Statistics of questionnaire

There are 0 enrolled students who can fill out the questionnaire.  
0 students have answered the questionnaire.  
0 students have also committed their answers already.  
Now, there are 0 completely answered questionnaires.

Figure 20: Coordinator overview - after setup or if you click the activity in the course you see an overview status as a course coordinator. Three tabs are provided: Overview, Group formation, Questionnaire preview



Overview   Group formation   Questionnaire (Preview)

### Group formation

Only students with at least one submitted answer will be considered for the group formation. This can be configured in the [Settings](#).

There are 0 student for group formation.

Start group formation   Delete groups   Adopt groups   Edit groups

*You have to close the activity to start the group formation.*


#### Evaluation

No data to display

#### Overview of generated groups

No data to display

Figure 21: Group formation - this tab is used later after data is collected from participants and the activity has been stopped on tab Overview.

Overview Group formation Questionnaire (Preview) 

This is a preview of the questionnaire.

1 Character 2 Learning 3

Character								
I see myself as someone who is generally trusting.	disagree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who is reserved.	disagree	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who tends to be lazy.	disagree	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who tends to find fault with others.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who gets nervous easily.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	agree
I see myself as someone who has an active imagination.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	agree

Figure 22: Questionnaire preview - depending on the settings the preview shows all the questions participants need to answer. This helps in case participants have questions and difficulties with some items. If filled as a course coordinator the answers are not used for later group formation. Only role 'student' in Moodle is considered.

## Step 2: data collection (participant view)

Overview - Group formation

Please fill out the questionnaire here to be added to learning groups on second course week by a course coordinator.

What is the "groupformation" for?

In this Moodle course the "groupformation" is used to build successful cooperating Homework groups. After you complete and submit the questionnaire, your appropriate learning partners will be determined. All details are kept confidential. Once the questionnaire is expired, the groups will be generated considering your data and preferences.

Questions, trouble or any suggestions? You can find the plugin developer and scientist under <https://github.com/moodlepeers> (created and developed with means for quality improvement of teaching at TU Darmstadt)

The questionnaire is ready for processing.

Figure 23: Participant overview: On first access participants see a short description and the description text you entered on setup.

Options

Consent (opt-in)

I want to participate in the groupformation plugin and agree to submit answers to the questionnaire. The participation or non-participation has no impact on the grading process (or the credit points).

- The instructor has no direct access to my answers for the group formation (just I am able to access the evaluation about my personality as well as the group average).
- My personal data will be deleted when the course ends - latest after 364 days.

☒ I agree to the terms

Give your consent and click "Next" to begin.

Next

Figure 24: participant consent - below the overview participants need to accept the opt-in dialog. If they do not they can still be matched into groups by random assignment (depending on your setup whether or not participants with no answers are excluded). The agreement can be revoked later on.

Overview Questionnaire Evaluation Group assignment Import/Export

1 Character 2 3 Team

Character

I see myself as someone who is generally trusting.	disagree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who is reserved.	disagree	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who tends to be lazy.	disagree	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who tends to find fault with others.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I see myself as someone who gets nervous easily.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	agree
I see myself as someone who has an active imagination.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	agree

Figure 25: Questionnaire tab - allows participants to jump between categories and save intermediate answers.

Overview Questionnaire Evaluation Group assignment Import/Export

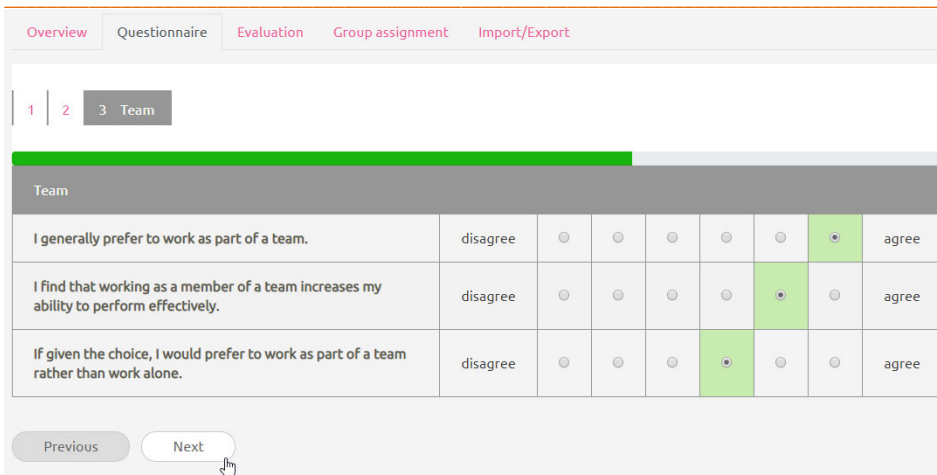
1 2 Learning 3 Team

Learning

I learn by feeling.	disagree	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I learn by doing.	disagree	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I learn by observing.	disagree	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
I learn by thinking.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree
When I learn, I am open to new experiences.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	agree
When I learn, I first consider all possible perspectives of the subject.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	agree

Figure 26: Questionnaire tab - the interface is mobile responsively designed (not shown on the screenshot)





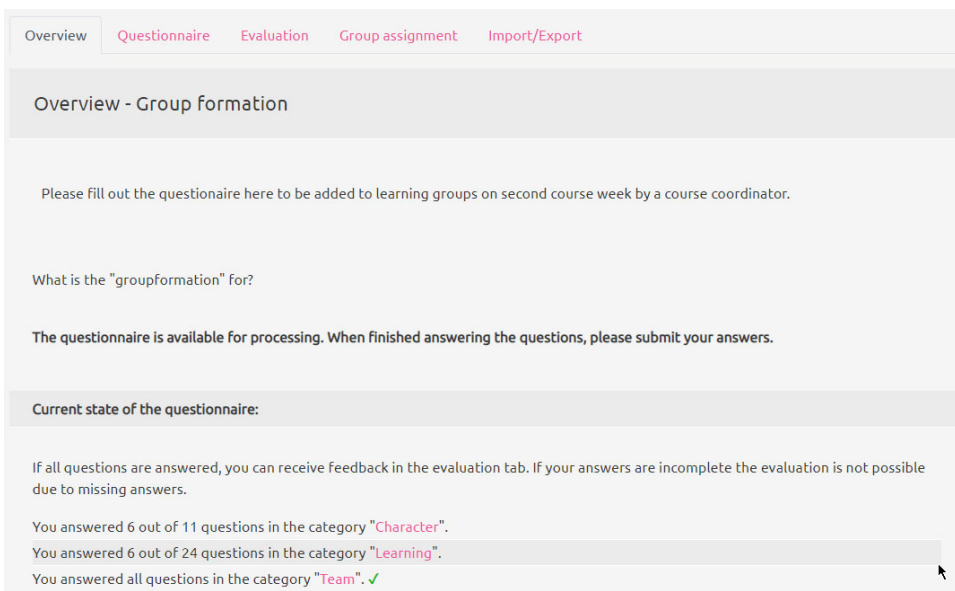
Overview Questionnaire Evaluation Group assignment Import/Export

1 2 3 Team

Team								
I generally prefer to work as part of a team.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	agree
I find that working as a member of a team increases my ability to perform effectively.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	agree
If given the choice, I would prefer to work as part of a team rather than work alone.	disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	agree

Previous Next

Figure 27: Questionnaire tab - a progress bar shows a rough estimation of completion



Overview Questionnaire Evaluation Group assignment Import/Export

### Overview - Group formation

Please fill out the questionnaire here to be added to learning groups on second course week by a course coordinator.

What is the "groupformation" for?

The questionnaire is available for processing. When finished answering the questions, please submit your answers.

**Current state of the questionnaire:**


If all questions are answered, you can receive feedback in the evaluation tab. If your answers are incomplete the evaluation is not possible due to missing answers.

You answered 6 out of 11 questions in the category "Character".

You answered 6 out of 24 questions in the category "Learning".

You answered all questions in the category "Team". ✓

Figure 28: After completion of the last questionnaire tab participants are redirected to overview, which shows the status of answers in each category. Prior studies indicated that the display with incomplete categories might encourage to finish questions later on.



**Current state of the questionnaire:**

If all questions are answered, you can receive feedback in the evaluation tab. If your answers are incomplete the evaluation is not possible due to missing answers.

You answered all questions in the category "Character". ✓

You answered all questions in the category "Learning". ✓

You answered all questions in the category "Team". ✓

Figure 29: On completion of all categories they are marked with a green arrow.



Options

Consent (opt-in)

I want to participate in the groupformation plugin and agree to submit answers to the questionnaire. The participation or non-participation has no impact on the grading process (or the credit points).

- The instructor has no direct access to my answers for the group formation (just I am able to access the evaluation about my personality as well as the group average).
- My personal data will be deleted when the course ends - latest after 364 days.

☒ I agree to the terms

Click "Edit" to continue the questionnaire or "Submit" to submit your current answers. You can also remove your consent, which also deletes all given answers, by clicking on "Remove consent".

Edit

Submit answers

Remove consent

Figure 30: On Overview, below the consent (opt-in) participants can remove consent (which leads to deletion of all answers), edit the questionnaire answers, or submit them finally. This leads to activity completion status.

Overview

Questionnaire

Evaluation

Group assignment

Import/Export

Overview - Group formation

Please fill out the questionnaire here to be added to learning groups on second course week by a course coordinator.

What is the "groupformation" for?

You have submitted your answers. Revert your submission or remove consent to start over.

Options

Click "Revert" to revert your decision to submit the questionnaire. You can also remove your consent, which also deletes all given answers, by clicking on "Remove consent".

Revert

Remove consent

Figure 31: after submission of answers participants can revoke the submission and re-edit their answers as long as the activity has not ended.

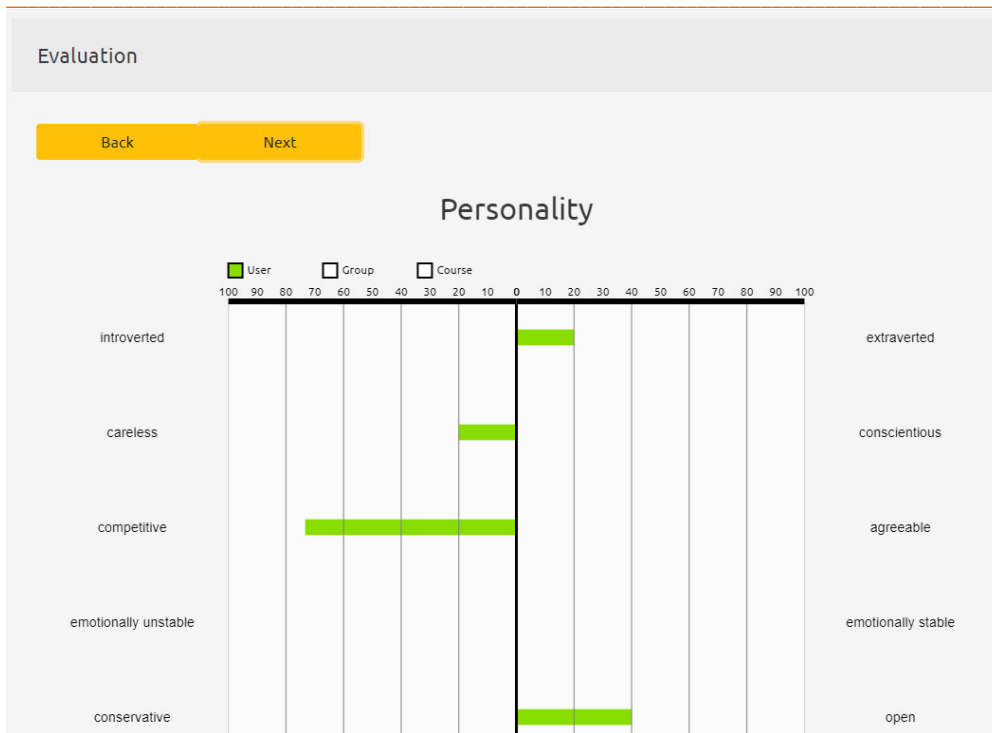


Figure 32: Evaluation tab shows statistical results to participants, if they submitted their complete answers. Depending on the setup it contains overview over personality traits and/or motivational aspects. After group formation finished there are as well bars to compare own values with the group mean value (for group size above 2) and the whole course mean value (for courses with more than 2 participants).

**Extraversion** ⓘ

Your answers suggest an average score on extraversion. Accordingly, you are probably enthusiastic to a rather moderate extent, and you are not particularly dominant or talkative.

**Conscientiousness** ⓘ

You seem to have a rather low score on conscientiousness. Accordingly one can conclude that you tend to be spontaneous and that you act rather careless and inaccurate.

**Social Agreeableness** ⓘ

Your low scores on agreeableness indicate that you are basically rather argumentative, egocentric and suspicious of the intentions of other people. You behave more competitively than cooperatively, have the ability to fight for your own interests and you are less yielding.

**Neuroticism** ⓘ

You appear to have an average score on neuroticism. Accordingly, you experience neither particularly often nor rarely anxiety, nervousness, tension, sadness, uncertainty and embarrassment. In stressful situations, you are neither particularly susceptible to problems nor especially robust towards them.

**Openness to experience** ⓘ

You have obtained average openness values. This indicates that you do not tend to very conventional nor to very unconventional attitudes and behavior. For you, visionary, imaginative disposition is balanced with pragmatic living in the here and now.

Figure 33: Evaluation tab - below the graphical overview a written statement helps in interpretation of the displayed data.

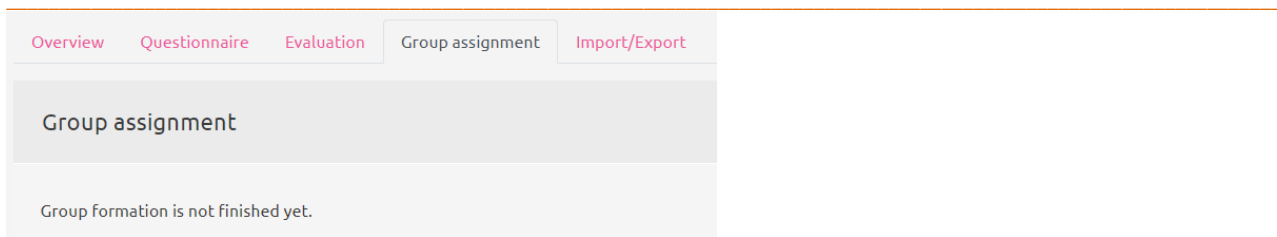


Figure 34: Group assignment tab - shows the group members with a link to their Moodle profile (to assist in contacting group members). Here empty as group formation has not yet finished.

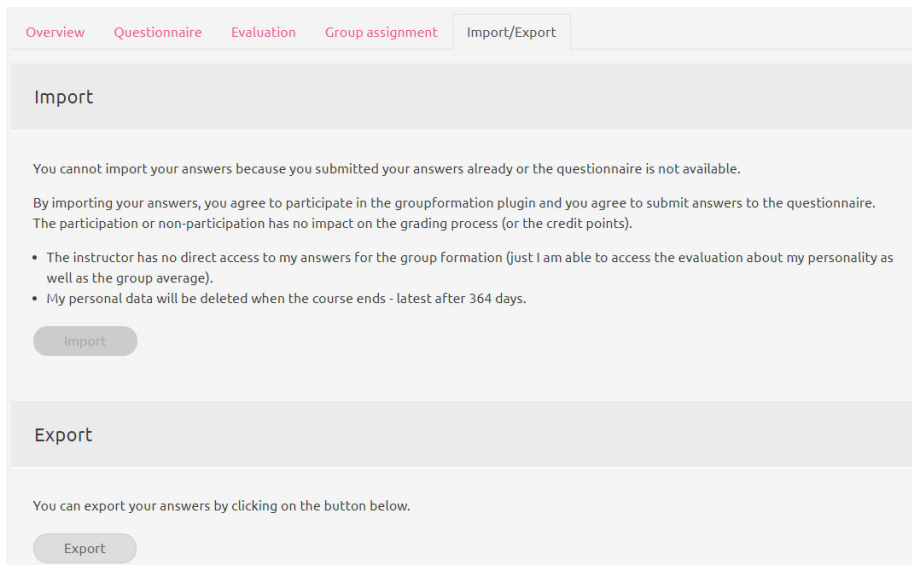


Figure 35: Import/export tab - if system administrators enabled import/export, participants can export their answers as XML files and later re-import them (e.g. in other group formation questionnaires). Thus, only remaining open questions need to be answered.

### Step 3: group formation (course coordinator view)

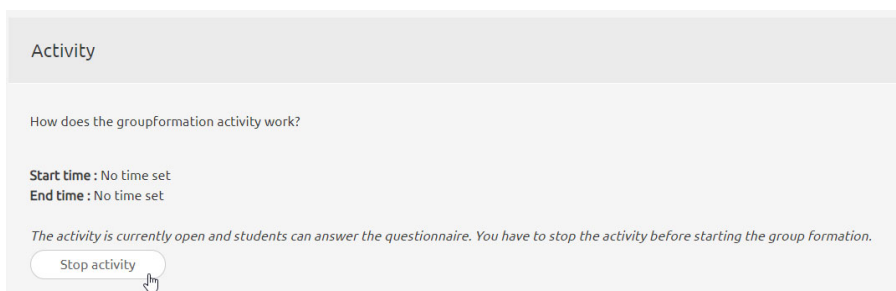


Figure 36: Activity end - when the deadline is reached or manually the activity needs to be stopped before groups can be build.

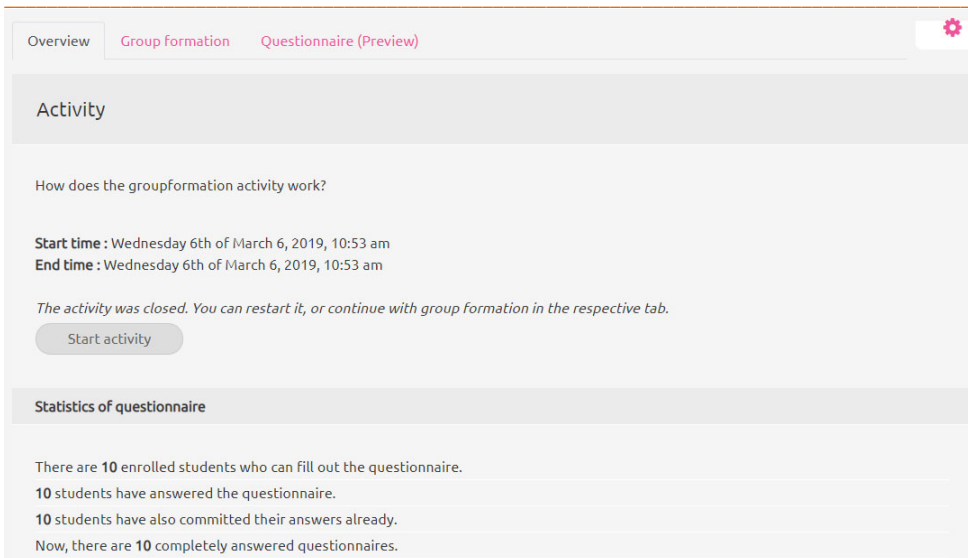


Figure 37: activity ended - when stopped the end date is shown and now group formation can be started

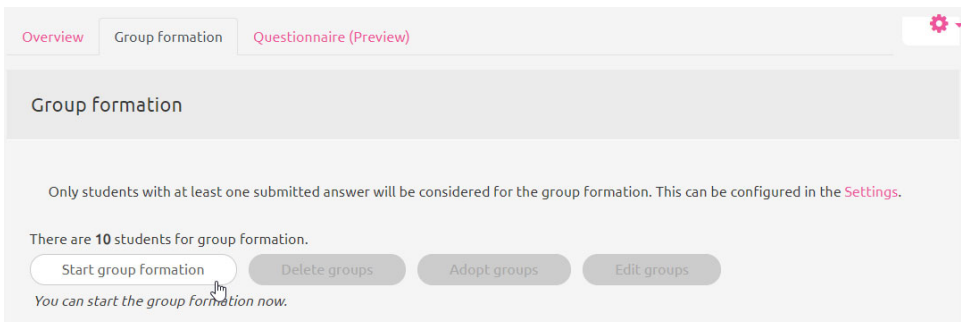


Figure 38: group formation - start the formation for the number of listed participants (the number respects the filtering by grouping and - if set in setup - by no answers).

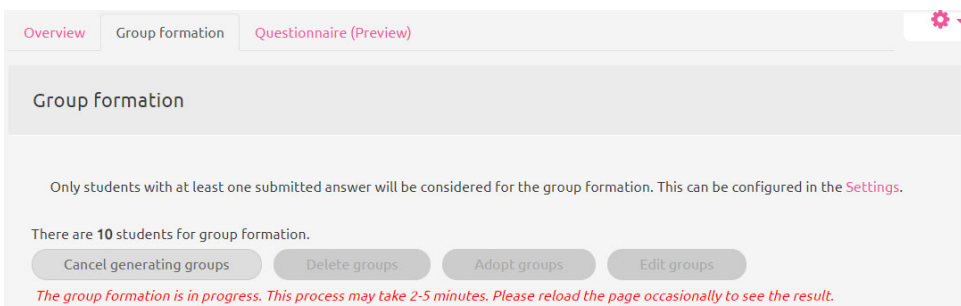
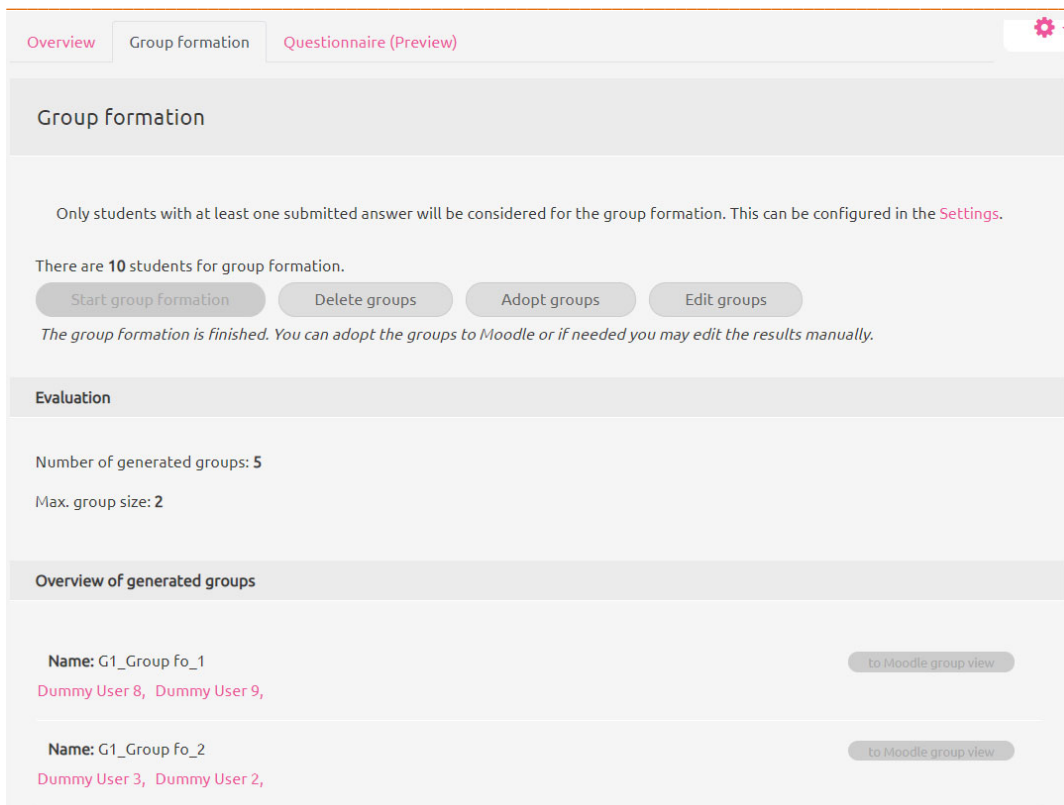


Figure 39: group formation runs - the job for group formation is runtime intensive and thus not performed directly but by Moodle cron jobs. Depending on the configuration of your Moodle this may take some time until the cron job starts (e.g. every 15 minutes). The calculation of groups is then ready within few minutes (depending on the number of criteria and participants). The algorithm was tested with up to 1000 participants and manyfold criteria (>100).



Overview | Group formation | Questionnaire (Preview)

### Group formation

Only students with at least one submitted answer will be considered for the group formation. This can be configured in the [Settings](#).

There are 10 students for group formation.

Start group formation | Delete groups | Adopt groups | Edit groups

*The group formation is finished. You can adopt the groups to Moodle or if needed you may edit the results manually.*

#### Evaluation

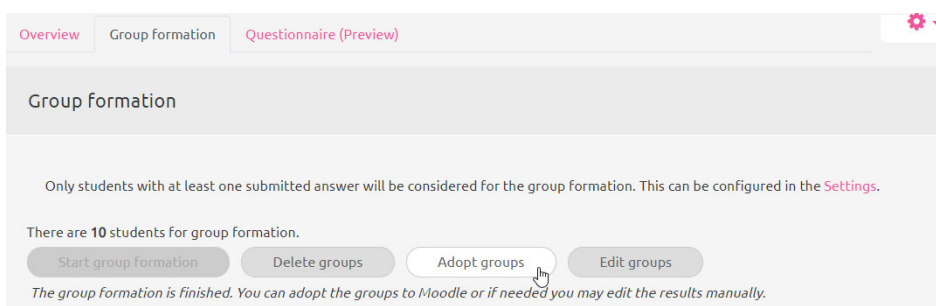
Number of generated groups: 5

Max. group size: 2

#### Overview of generated groups

<b>Name:</b> G1_Group fo_1 Dummy User 8, Dummy User 9,	to Moodle group view
<b>Name:</b> G1_Group fo_2 Dummy User 3, Dummy User 2,	to Moodle group view

Figure 40: group formation done - to see the result of the group formation you need to reload the page manually. In the example here, the group size was set to 2 and resulted in 5 groups (2 are shown on the screen, the rest below is not visible)



Overview | Group formation | Questionnaire (Preview)

### Group formation

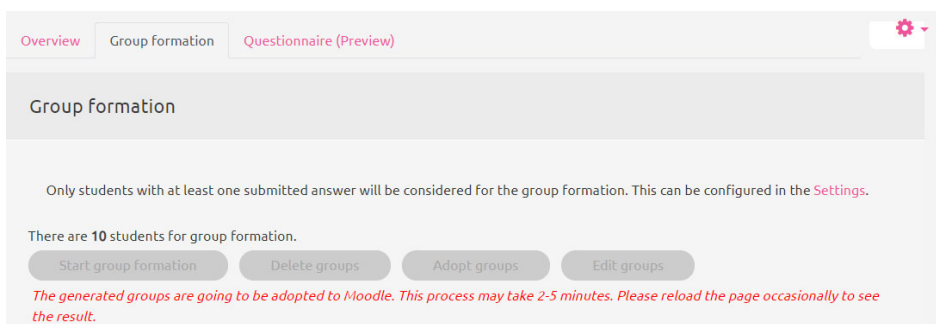
Only students with at least one submitted answer will be considered for the group formation. This can be configured in the [Settings](#).

There are 10 students for group formation.

Start group formation | Delete groups | Adopt groups | Edit groups

*The group formation is finished. You can adopt the groups to Moodle or if needed you may edit the results manually.*

Figure 41: group creation in Moodle - when you are satisfied with the result the groups can be created as Moodle groups. Therefore, click 'adopt'. This is as well a cron task which is done as soon as the next cron cycle in Moodle happens. Ask your system administrator how often Moodle cron is starting (Moodle documentation v3.6 and above recommends every 1 minute).



Overview | Group formation | Questionnaire (Preview)

### Group formation

Only students with at least one submitted answer will be considered for the group formation. This can be configured in the [Settings](#).

There are 10 students for group formation.

Start group formation | Delete groups | Adopt groups | Edit groups

*The generated groups are going to be adopted to Moodle. This process may take 2-5 minutes. Please reload the page occasionally to see the result.*

Figure 42: moodle group creation - a red text informs about the cron job to be added.

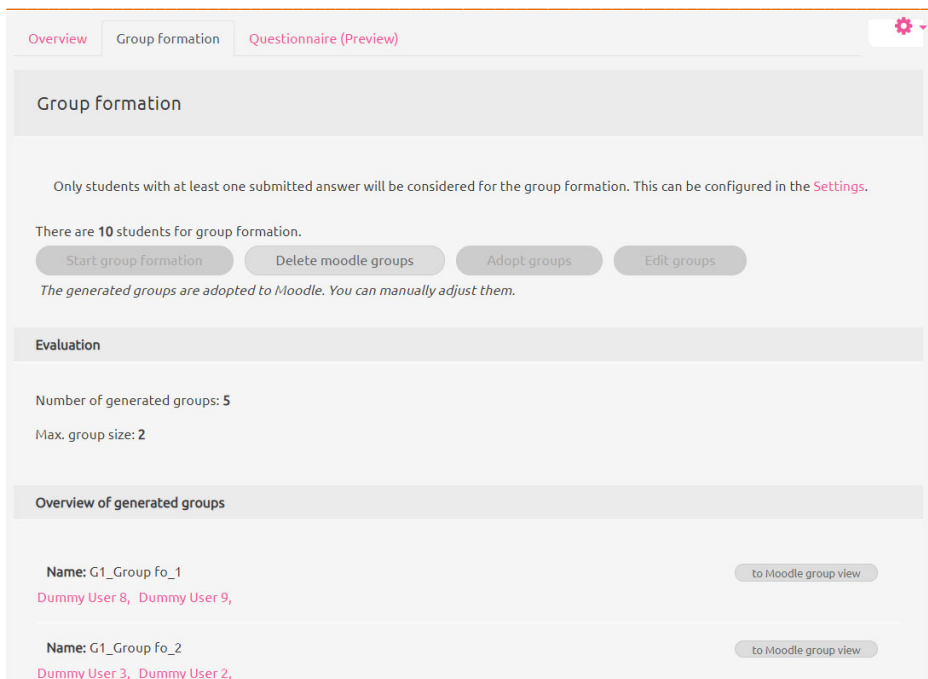


Figure 43: moodle group creation - the groups are created in Moodle. Editing is only possible manually now.

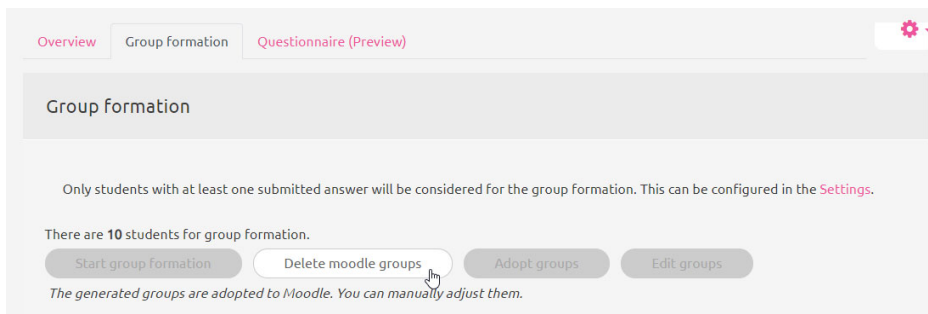


Figure 44: moodle group deletion - you can delete all created Moodle groups as the plugin tracks their IDs internally. Afterwards new group formation is possible. Attention: All changes you might have made with the groups elsewhere are lost, too.

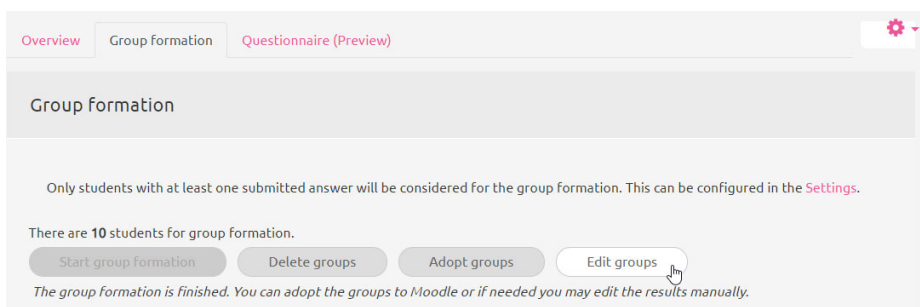


Figure 45: edit group proposal - instead of directly adopting groups to Moodle you can edit the proposed group formation

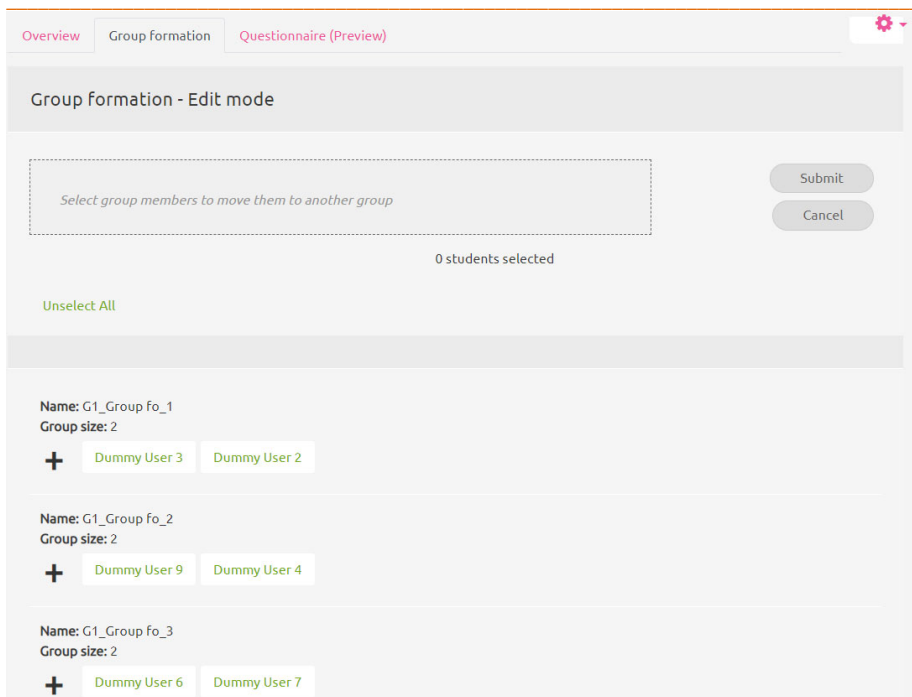


Figure 46: group editing - the dialog for editing contains a clipboard of participants on top and the current group constellation below.

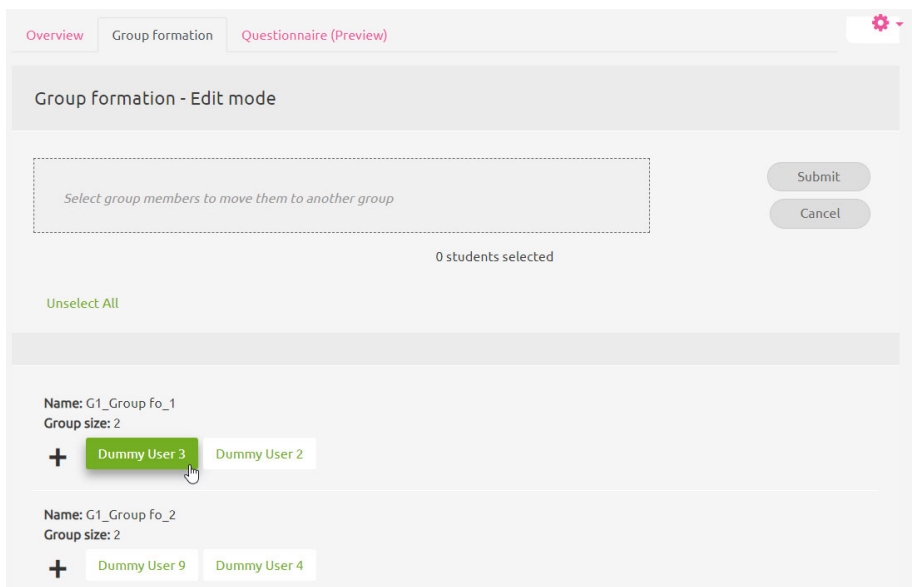


Figure 47: group editing - click on users to add them to the clipboard

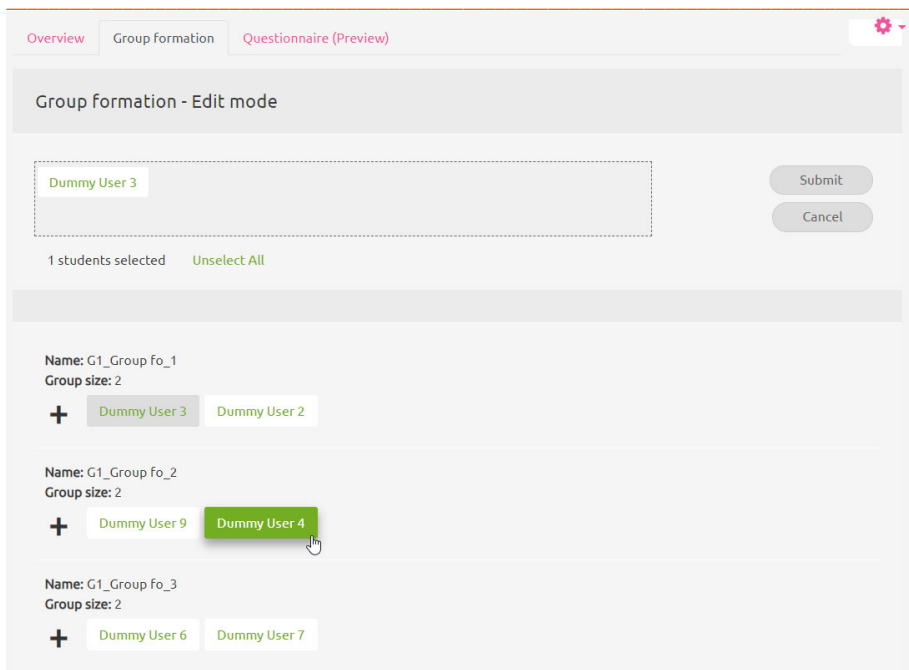


Figure 48: group editing - click on users to add them to the clipboard (second example)

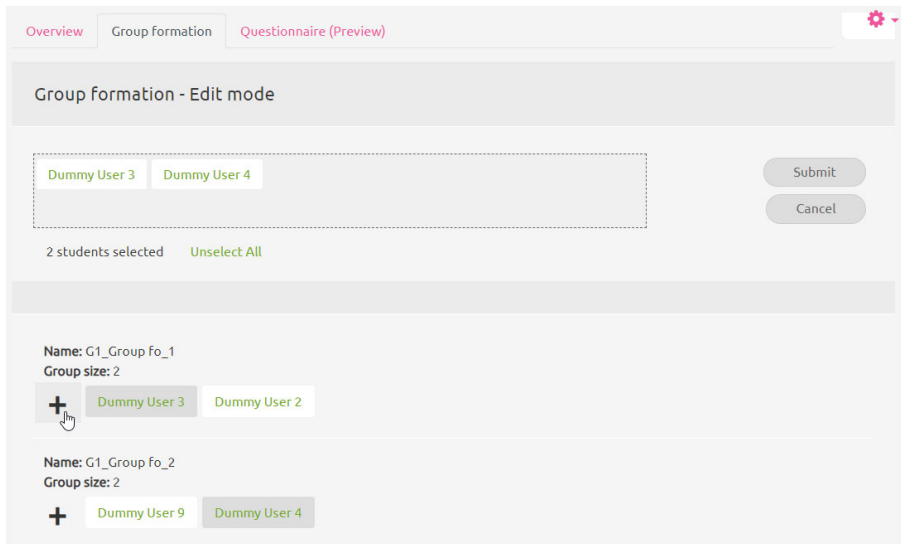



Figure 49: group editing - to insert into a group click on the plus (+) symbol next to a group to activate this group as the target for pasting



Overview Group formation Questionnaire (Preview) 

Group formation - Edit mode

Dummy User 3

Dummy User 4

2 students selected [Unselect All](#)

Submit

Cancel

Name: G1\_Group Fo\_1  
Group size: 2

+ 

Dummy User 3

Dummy User 2

Name: G1\_Group Fo\_2  
Group size: 2

+ 

Dummy User 9

Dummy User 4


Name: G1\_Group Fo\_3  
Group size: 2

+ 

Dummy User 6

Dummy User 7

Figure 50: group editing - if you now click on participants from the clipboard they are moved to the target group (here User 4 to G1\_Group Fo\_1)

Overview Group formation Questionnaire (Preview) 

Group formation - Edit mode

Dummy User 3

1 students selected [Unselect All](#)

Submit

Cancel

Name: G1\_Group Fo\_1  
Group size: 3

+ 

Dummy User 3

Dummy User 2

Dummy User 4

Name: G1\_Group Fo\_2  
Group size: 1

+ 

Dummy User 9

Name: G1\_Group Fo\_3  
Group size: 2

+ 

Dummy User 6

Dummy User 7

Figure 51: group editing - the group memberships are updated (here: User 4 has been moved to Group 1)

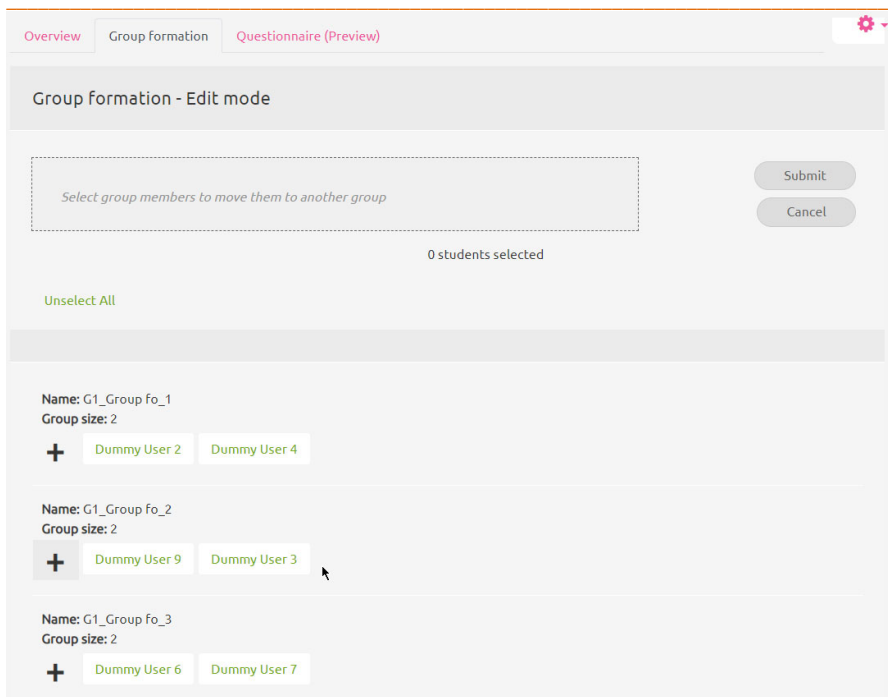


Figure 52: group editing - by selecting another group as target (here Group 2) and then clicking User 3 from the clipboard, this user has been moved, too. (now User 3 and User 4 switched groups finally)

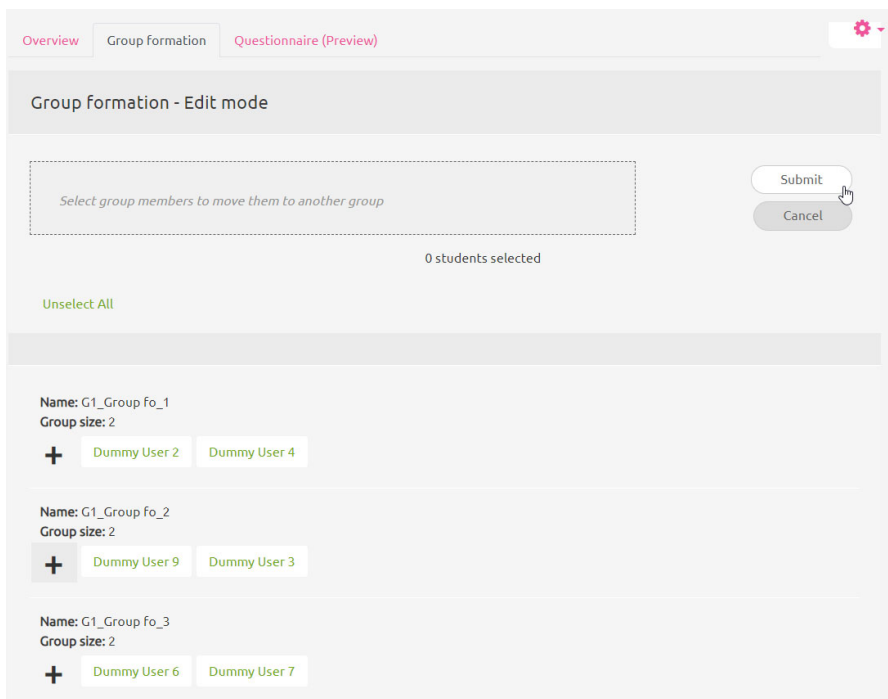


Figure 53: group editing - to keep the changes, click 'submit'. Otherwise the group proposal remains as before editing.

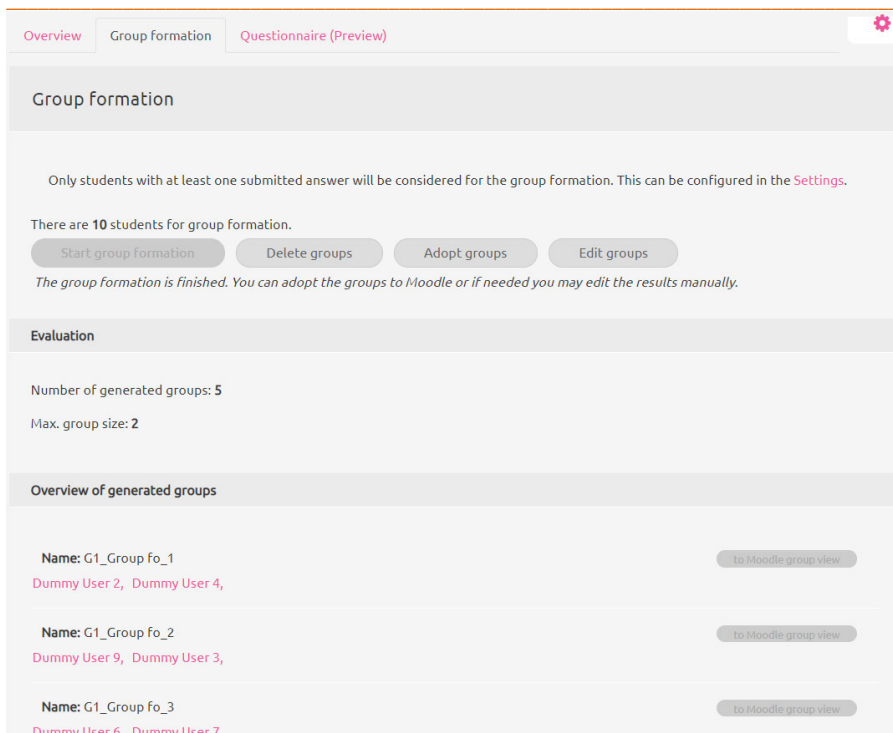


Figure 54: group editing - the changes made are reflected in the group formation tab view. The new group constellation can now be adopted to Moodle groups.

## A2 Details about plugin installation

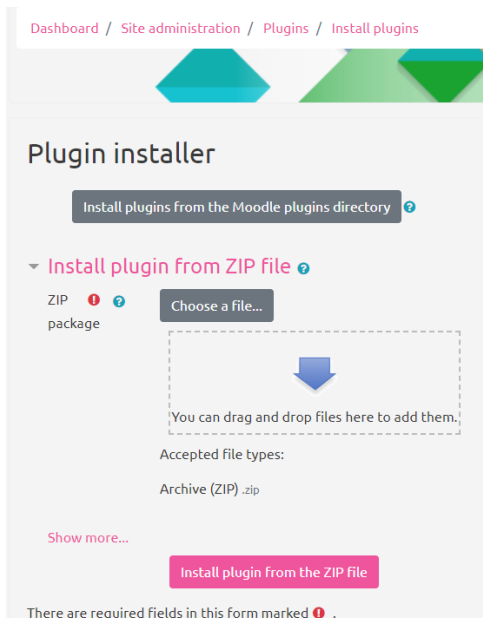


Figure 55: plugin installation - as admin user either drop a ZIP of the whole plugin repository or select 'groupformation' from the Moodle plugin directory. Another way for advanced users is to manually checkout the git repository into your moodle subfolder /mod/groupformation . Moodle will recognize on next admin login and prompt you for installation of the new found plugin. Same works work for plugin updates (if version is never, Moodle prompts for updating).

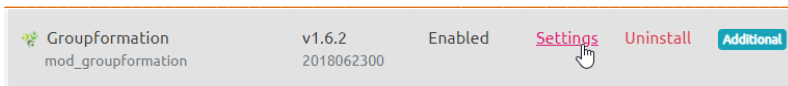


Figure 56: plugin installation - after installation you are directly forwarded to the settings of the plugin. Lateron, click in 'Settings' in the plugin list of installed plugins

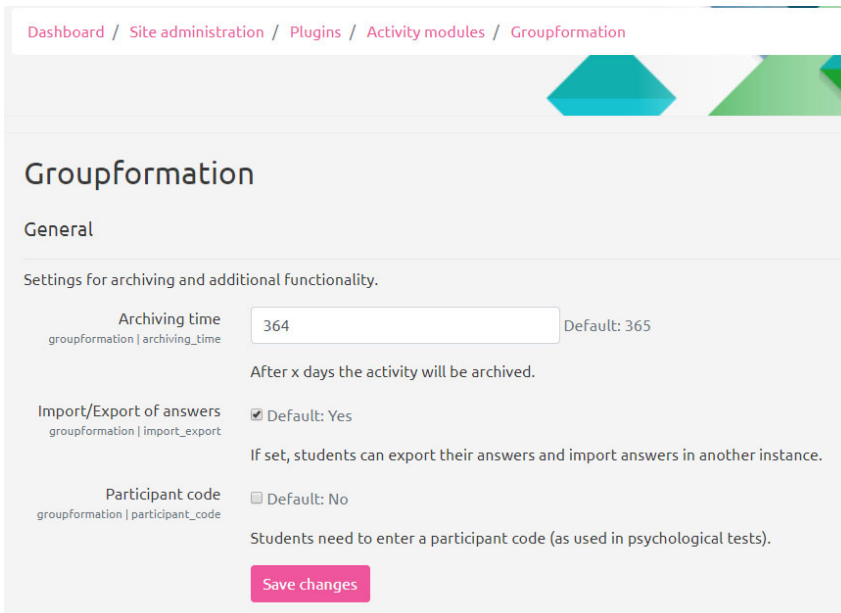


Figure 57: plugin settings - the system wide settings allow you to set a maximum age of personal data of participants (e.g. questionnaire answers). They are deleted by cron jobs on that age. The number set here is displayed to participants when they submit their consent (opt-in) for the group formation activity. Administrators can allow/restrict export/import of questionnaire answers as XML-files. The last option allows to ask participants for an individual code, which is then included in the XML-download data. This is useful if you plan to re-use the anonymized answers to questionnaires in a scientific study and want them associated with a certain participant code (e.g. distributed by you before).