Developing Methodology for Online Training in Bioinformatics and Database

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Contents

This document is intended to inform and help tutors and educators on the approaches they could take up in providing online learning to students in the field of Bioinformatics and Databases.

Distance learning requires instructors to rethink significant parts of how education is delivered. The traditional way of teaching provides students and instructors with a physical space to gather together and sets the time and structure for the course. In the case of CE, the course often takes place at an organized professional meeting. This face-to-face gathering provides a venue for verbal communication and a means of engaging student attention and monitoring their understanding and progress throughout the course. The framework for awarding course credit is based on whether or not students come to the course. If students come and stay the required number of hours, they receive credit. All of these measurable phenomena are no longer true when providing continuing education over the Web.

In using this new mode of offering education, developing a different model for dealing with these processes was necessary. In order to conceptualize this model, the instructors started by asking themselves a series of questions that addressed the following issues: student expectations, content, content presentation, teaching components, interaction between students and instructors.

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Planning distance learning courses

When planning distance learning there are several steps that need to be taken to ensure that teaching process goes as smoothly as possible. It is important to keep in mind the **expectations of students** who often expect the same quality of teaching despite the different delivery method of the course. This included **clear and logical presentation** of information, **interactivity** with the other students and the instructors, and **adequate instructor feedback** regarding students' understanding of the material. In addition to these traditional classroom criteria, students could select a Web-based alternative because of the flexibility to complete the course at their own pace, without the inconvenience and expense of travel.

Popular platforms for online meeting have created a relatively straightforward environment for student navigation, while maintaining a professional look. The learning curve for using Zoom, MS Teams and Google Meet is relatively flat, both for the instructors and the students. It's fairly simple for instructors to input information, track students, and create assessments.

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Technological tools and format

Many institutions prefer to use several different platforms to deliver their courses – depending on the available platforms, the courses could be delivered either live – as in the teacher delivers the lecture live on a platform (e.x. Zoom, Google Meet, MS Teams) or recorded, so they could be put into a server or a cloud server that students have access to. It is a good practice to record the live lectures, so students could watch them again and again, if they need to. The benefit of that is that live online meetings between students and professors could be used for discussions, answering questions or practical exercises.

There are many other tool available, to keep track of students and their progress, to help in assessing students and other. One of the platforms, that offers significant amount of functions and are free is **Google Classroom[1].** The platforms allows for instant messages between students and instructors, a calendar of the course with the lectures and or exercises that are going to be held, pinning important information (for example – a test, homework exercise or other message). The platform allows instructors to give marks to students after each lecture/exercise/homework and is compatible with other Google functions, like Google Forms. Forms could be used for testing, exercising or homework.

Depending on the needs and learning curve and price of the platforms, instructors can choose among many different available sites and applications, like Canva, Pear Deck, Edmondo, Kahoot and others. Most of those platforms have available resources, like teaching templates for presentations, templates for testing or templates for group projects.

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[1] Using Google Classroom is free.

The platforms should help the instructors to engage the interest of students, allow for group projects and discussions and fit the needs of the particular course.

Review of Topics

The distance-learning instructor should have a clear idea what they want their students to learn and what is the basic body of knowledge, upon which the course is built upon is. The foundation of the course is built upon set of topics that the course addresses and leads to set of activities (lectures, readings, exercises, testing, etc.). It is important that specific closely related topics are taught close in time to one another and that they build up from a more basic to a more complex understanding of the topics.

Module 1	Module 2	Module 3	Module 4
• Topic 1	• Topic 3	• Topic 5	• Topic 7
• Topic 2	• Topic 4	• Topic 6	• Topic 8
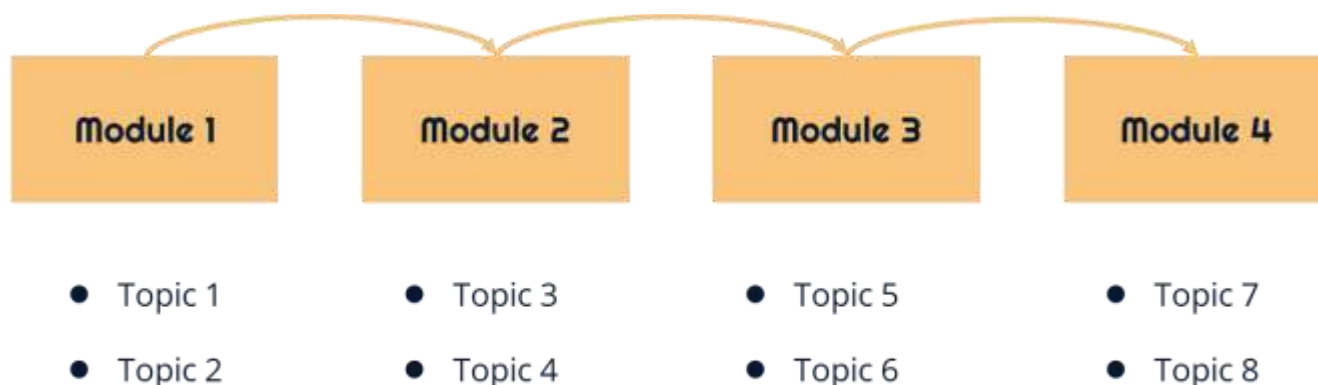
Those topics could be arranged in **modules.** For example, an 8 week course could have 4 modules with two topics with each topics containing a lecture in which the instructor puts emphasis on certain topic points, theory – based reading assignment, a laboratory or other type of exercise, a case study, an assignment and/or a test.

It is important for the instructor to be able to envision which topics could be used for encouraging interactive communication between students and teacher. Some of the topics that spark interactive communication are usually found in the grey areas of knowledge – things that could not be right or wrong. Those areas should be explored with the instructor and through discussions with other students. They are also a great source of exercises like case studies. Another way to spark discussions for each of the topics within a module is to have

students present a basic theory or body of knowledge that was the theoretical part of the topic. That can spark the interest of students and level up their engagement, since they may feel freer to discuss them with their classmates.

It is important that each topic is presented with a clear beginning and end and not overwhelm students with too much information. Students should be able to understand what they were taught – basic concepts and theory. That way it would be easier to test their ability to understand the information that they were presented with in any form of evaluation they might be subjected to.

Topics should be arranged in a way that would enable students to slowly enter into more complex ideas and theories, starting with the basic concepts and theories and progressing towards more complex ones.

Review of the Texts

One approach to encourage interactive communication between teacher and students would be to have the **basic body of knowledge in text** making it into a mandatory reading for the class. That way, students could learn the basic theory (right vs. wrong answers) and use the time with their teacher to discuss the practical aspects of the topics. Teachers could then put **emphasis on the ways that this particular knowledge is applied to solve real world problems** and discuss other questions that students might have had reading the text. This supplemental information reinforces the student's

commitment to learn and ties the foundation basics to reality. Selection of a quality text which meets the needs of a distance-learning course promotes and supplements the student's self-directed learning process.

If the texts are going to be used in that manner, it is important that they completely cover the material which makes up the foundation body of knowledge for the course. Additionally, the text must be technically accurate, readable, concise and preferably filled with graphics (to accommodate visual learners). Finally, interjection of probing questions by the faculty member forces the student to use his newly acquired knowledge in wrestling with answers which fall into grey areas usually not covered in the textbook. To encourage participation and interaction during the online courses, it could be useful to allocate some percentage of the final grade to the student's online participation.

It is best to design the course sequence to produce a range of outputs. Arrange the course around a body of knowledge driven by a textbook reading assignment, and then supplement the foundation with applied, instructor led exercises. Sufficient time should be allowed for presentation, learning and testing on each topic.

It is especially important for the text to be divided into chapters and subheads that have a clear beginning and an end. The beginning of the chapter should clearly state the goals of the chapter. It is very important to use visual materials like graphs, pictures and maps. Beginning of the chapter should also include any hyperlinks or external resources that might be needed in the chapter and/or subsections of the chapter. All visual materials should be accompanied by a text that explains them. Chapters could include some form of self-test.

Activities review

Faculty members should think about activities that support, supplement or reinforce the body of knowledge of the course. Those activities don't have to be the same activities, that faculty members have used in their previous deliverance of the in-person course. They have to be possible and easy to do in an online environment and could take different forms like case studies, games, simulations, essay assignments– compare and contrast, problem solving assignments and research assignments.

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Activities in teams works well with online environment - small teams of 3 to 4 students could try and solve a more challenging problem together. In addition to providing a supplemental learning environment for mastery of course content, teams also provide students with an opportunity to develop and refine teamwork skills which are needed to succeed in the workplace.

Developing appropriate testing tools could also be a challenge, since not all the tools used for testing in a classroom environment might be applicable or adaptable for an online environment. What the faculty members should keep in mind is that the testing tools should be able to ensure that the topic material has been mastered by the students.

Learning styles of students

In order to be able to deliver the body of knowledge that the course consists of in an effective manner that knowledge should be accommodating to every students' learning style. This means that the teaching style of the faculty member as well as the course materials should be adapted to suit the needs of the learning styles of students and not the other way around.

There are many different classifications of learning styles, but most often they are categorized as Visual learners, Auditory learners and Tactile/Kinestethic learners. It is based on Walter Burke Barbe **VAK theory**. According to the theory everyone has strengths, weaknesses and preferences in each of the three modalities. The most effective learning utilized all three in combination.

Visual learners learn best when they are reading and seeing visualizations (graphics, pictures, maps). They might have some difficulties when they receive spoken directions and may be easily distracted by sounds. They respond best to instructions and or theory that paints a picture in their head. They respond well to color coding.

Auditory learners learn best when they are listening. They understand and remember things they hear better than they do, when reading them. They responds best to voices, for example, in a lecture or group discussion. Hearing their own voice repeating something back to a tutor or trainer is also helpful for them.

Tactile/Kinestethic learners learn best by doing things or by creating things with their own hands. They learn best when there is some type of physical activity involved. They like deconstructing and reconstructing things to understand them better. They respond better when they learn using a computer, rather than listening or reading, because it involves physical activity in the learning process (moving their fingers on the mouse or keyboard, etc.)

Another theory on differentiating learning styles is the **FSLSM model** (the Felder-Silverman learning style model). There are four dimensions in FSLSM. Each learner is characterized by a specific preference for each of these dimensions.

- The first dimension distinguishes between an *active* and a *reflective* way of processing information. *Active* learners learn best by working actively with the learning material, by applying the material, and by trying things out. They tend to be more interested in communication

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with others and prefer to learn by working in groups where they can discuss about the learned material. In contrast, reflective learners prefer to think about and reflect on the material. Regarding communication, they prefer to work alone or maybe in a small group together with one good friend.

- The second dimension covers sensing versus intuitive learning. Learners who prefer a *sensing* learning style like to learn facts and concrete learning material. They like to solve problems with standard approaches and also tend to be more patient with details. Furthermore, sensing learners are considered to be more realistic and sensible; they tend to be more practical than intuitive learners and like to relate the learned material to the real world. In contrast, *intuitive* learners prefer to learn abstract learning material, such as theories and their underlying meanings. They are more able to discover possibilities and relationships and tend to be more innovative and creative than sensing learners.

- The third, visual-verbal dimension differentiates learners who remember best and therefore prefer to learn from what they have seen (e.g., pictures, diagrams and flow-charts), and learners who get more out of textual representations, regardless of whether they are written or spoken.

- In the fourth dimension, the learners are characterized according to their understanding. *Sequential* learners learn in small incremental steps and therefore have a linear learning progress. They tend to follow logical stepwise paths in finding solutions. In contrast, *global learners* use a holistic thinking process and learn in large leaps. They tend to absorb learning material almost randomly without seeing connections but after they have learned enough material they suddenly get the whole picture. Then they are able to solve complex problems, find connections between different areas, and put things together in novel ways but they have difficulties in explaining how they did it. Because the whole picture is important for global learners, they tend to be more interested in overviews and in a broad knowledge whereas sequential learners are more interested in details.

Teaching styles to accommodate all types of Learners

As much as possible, teachers should relate the material being presented to what has come before and what is still to come in the same course, to material in other courses, and particularly to the students' personal experience

They should provide a balance of concrete information (facts, data, real or hypothetical experiments and their results) and abstract concepts (principles, theories, mathematical models).

Balance material that emphasizes practical problem-solving methods with material that emphasizes fundamental understanding.

Provide explicit illustrations of intuitive patterns (logical inference, pattern recognition, generalization) and sensing patterns (observation of surroundings, empirical experimentation, attention to detail)

Follow the scientific method in presenting theoretical material. Provide concrete examples of the phenomena the theory describes or predicts. Develop the theory or formulate the model; show how the theory or model can be validated and deduce its consequences and present applications

Use pictures, schematics, graphs, and simple sketches liberally before, during, and after the presentation of verbal material. Show films is applicable. Provide demonstrations hands-on, if possible.

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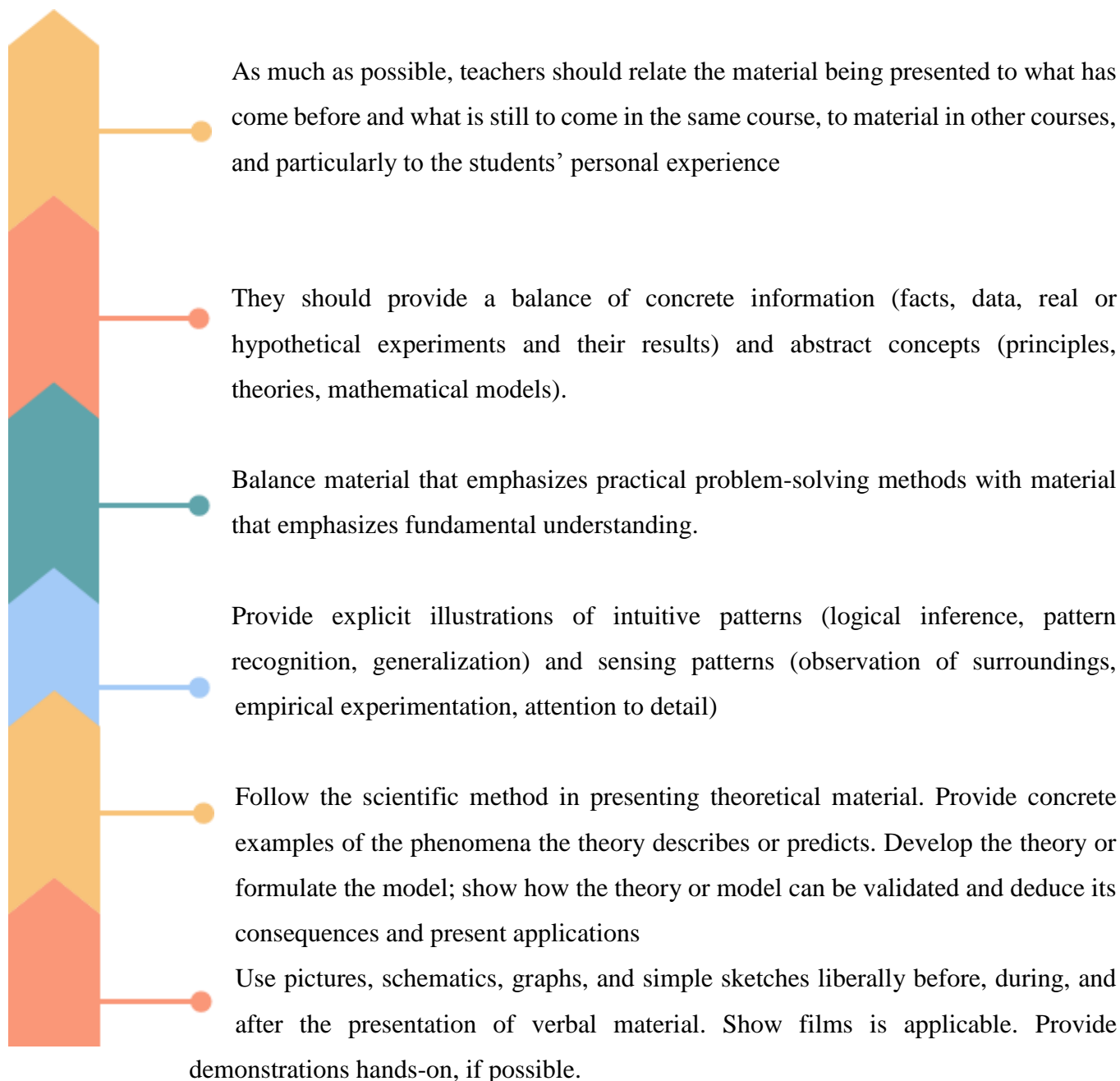MART UNIVERSITESI,
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Do not fill every minute of class time lecturing. Provide intervals—however brief—for students to think about what they have been told.

Provide opportunities for students to do something active besides transcribing notes. Small-group brainstorming activities that take no more than five minutes are extremely effective for this purpose.

Assign some drill exercises to provide practice in the basic methods being taught but do not overdo them. Also provide some open-ended problems and exercises that call for analysis and synthesis.

Give students the option of cooperating on homework assignments to the greatest possible extent. Tactile learners generally learn best when they interact with others. If they are denied the opportunity to do so they are being deprived of their most effective learning tool.

Applaud creative solutions, even incorrect ones

Talk to students about learning styles, both in advising and in classes. Students are reassured to find their academic difficulties may not all be due to personal inadequacies.

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Some useful test to determine your students' learning styles are:

Testing students for their style of learning will help in planning the course and in executing exercises, discussions and group project. It will help the effectiveness of teaching and would engage students to participate more. The following test have been developed to help teachers and students determine their learning style

- http://www.educationplanner.org/students/self-assessments/learning-styles.shtml - The test uses the basic three types of categories of learners. The results of the test usually determine the percent to which the student is a Visual, Auditory or Tactile learner. (**VAK theory)**

- https://www.webtools.ncsu.edu/learningstyles/ - The Index of Learning Styles (ILS) is a self-scoring web-based instrument that assesses preferences on the Sensing/Intuiting, Visual/Verbal, Active/Reflective, and Sequential/Global dimensions. It is available free to individuals and instructors who wish to use it for teaching and research on their own classes. (**FSLSM model)**

Good ideas and practices:

- **Discuss and look for recommendations:** Whenever possible, when planning a distance-learning course, it is always a good idea to have a colleague or a team of colleagues review your plans and the tools that you are going to be using. They might have useful suggestions and know about better ways to facilitate certain exercises, discussions or teamwork projects.

- **Test the tools out:** It is important for teachers/faculty members to know the tools they are going to need for the teaching process. It is always a good idea to test them out and have a student that is not taking the course or other faculty member test the materials beforehand. There may be something that seemed logical at the time of constructing the course that is out of place in the final version of it or might be leading into another topic, that is not addresses in the next module of the course.

- **Make sure students have the needed hardware and software:** In the beginning of the course, it is important for faculty members/teachers to make sure their students have the necessary hardware

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(microphone, camera, PC/laptop, tablet) to be able to participate. In addition, they should be able to install any software that they might need for the course. If a student isn't able to install the software, faculty members should be able to figure our a supplementary online platform or other form of software that would enable the student to continue their course. When planning the teaching tools, it is important to use tools that have an substitute that uses lower CPU or is web-based.

- **Get feedback:** After the end of the course, students would be able to give informed feedback on the structure of the course and on the way that the material was presented. It may be the case, that some of the students feel like their learning needs weren't met (for example, they are a visual learner and the course did not include much visualization). Student's feedback would help further adapt the course and potentially make it more effective in it's use of tools, texts, other materials and activities.

Step-by-step guide on planning distance courses:

1. **Faculty meeting:** It is always a good idea to hold a faculty meeting to decide on the platforms that are going to be used for distance learning and decide on one or two platforms, so students do not get lost as to where their classes are going to be held. The platforms should accommodate the needs of all the classes that the students are going to have and should not be difficult to navigate or use for both faculty and students. The faculty meeting or meetings could also be used to exchange practices on keeping student's attention, making the classes more interactive and grading day-to-day performance of students.

2. **Planning the time with students:** Planning for the time that students will have with the faculty member is going to give answers to questions on how the basic body of knowledge would be presented to students

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(via a text book/articles and other materials that would be a required read for the students) or via lectures. Based on that decision, plan other activities such as exercises, group activities, testing, etc.

3. **Planning the materials:** When the faculty member has a clear idea of how they want to structure the course, it is time to think about the materials that they are going to be needing – basic body of texts, basic plan on the specific topics that they will be addressing as well as a plan no testing students on their understanding of the topics and materials. After planning the materials, the faculty member should make sure they gather or create the materials they will need for their course – presentations, texts, exercise and so on.

4. **Planning the activities:** When the structure and the materials are planned, it is time for activities to be planned – how is the faculty member going to make sure they engage all students in their work, how are they going to stimulate students' participation in discussions, tackling a difficult task via team projects and etc.

5. **Starting the course:** The beginning of a course is the best moment to test the students' learning styles and understand what their learning needs are going to be. This is the moment, when faculty member might be able to adapt their materials/presentations or other materials to help accommodate all types of learners. If the materials are accommodating to all learning styles, there will be no need to adapt them any further, but might mean that there may be a need to plan new or alternative activities.

6. **Getting feedback:** It is important to gather the student's feedback on the platforms used (were they easy enough to use, did they have all the functions that the students needed to complete their exercise/test/group project). This will help the faculty member to further adapt their course to the needs of their students.

Course presentation template can be designed as part of the development of distance-learning course. The template may consist of the following:

✓ Defining of overall learning objectives
✓ Defining of the users/target groups of the course

✓ Defining of the expected learning outcomes

✓ Defining of the scope of the training and methods

✓ Defining of course structure – number of modules, names of the modules, content of the modules

✓ Defining of assessment methods

An example of course presentation template:

Course name:	
Teacher:	
Users/target groups of the course:	
Length of the course:	
Overall learning objectives:	
Expected learning outcomes:	
Expected skills, knowledge and competences (according to National Qualification Framework):	
Course content:	
Number and name of modules in the course:	
Assignments during the course:	
Research activities during the course:	
Opportunities for meeting with real work professionals and specialists: (optional)	
Course literature list:	
Assessment methods:	
Possible relations to the labor market:	
Meeting hours and consultations:	