Cross-Disciplinary Remote Course for Mixed Group of Students and Professionals

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Abstract. The vast amount of openly available information enables data-driven study of the surrounding world. The aim of this article is to present dissemination of methods to calculating exhaust gas emission and assessing the effect of weather in dispersion of said emissions that are possible to carry out with data from open data repositories. As the measures to prevent spread of COVID-19 virus has led to a temporary cease of contact learning, this course is implemented remotely online. The course offers a controlled environment to test the foreknowledge of the participants regarding environmental challenges tied in transport, and the effectiveness of the remote course in enhancing the awareness in said issues. Data will be gathered on the success of the course. It is used to enable continuous improvement of the course in terms of quality of the content and successfulness of the remote setting. In addition, the gathered data is used to determine the effectiveness of remote education and the preparedness of scholars to operate under special conditions. Through collaborative effort of the course organizers and attendees, the remote implementation can be successful. Also, the mixed group of organizers, students and professionals enable problem-oriented approach to the topic that is difficult to limit into a specific discipline. The pandemic and succeeding mitigation of COVID-19 spreading showcases the importance of planning education for such special situations. While the resulting circumstances are not pleasant, they serve as a promoter for rigorous planning of educational events.

Keywords: Road traffic emissions • Road weather • International • Cross-disciplinary • Education

1 Introduction

The recent concern on environmental sustainability of human presence on earth has sprung action towards lowering the negative environmental impact of all sectors. One of the major contributing factors to enhanced environmental sustainability of existence is education of this subject matter. Through knowledge will the current and coming generations be able to perform informed decision-making on legislation and regulation as well as in organizations or at individual level. The current targets globally towards reduced emissions are relatively strict when considering the short timeframe they have been scheduled. For example, massive reductions in EU are set to be reached by 2030
Therefore, it is vital for achieving those goals to spread the knowledge on possible emission mitigation methods to existing professionals. Furthermore, the acquainted perception on status quo by those professionals enhances the relevancy of education passed to aspiring professionals, i.e., university students.

As the ongoing COVID-19 pandemic has forced almost all nations to act under special conditions, educational activities must also adapt to these circumstances. Social distancing practices have forced majority of the universities to close their doors, effectively ceasing all contact learning. Thus, remote courses have emerged as the focal part of higher education [2]. Whereas certain courses have been carried out remotely in the past, most of the courses must be implemented such way during 2020. While incumbent view has been that remote learning, e.g., via online, is not as effective as conventional contact learning, this forced “experimental” setting could prove that modern technologies can enable a sound learning environment by essentially removing the spatial and temporal constraints of a physical class. In addition to educational effectiveness, remote learning can significantly enhance the environmental sustainability of education by mitigating, e.g., travel and the need for printed material [3]. Furthermore, in the setting of higher education, concept of environmental sustainability extends from substantial means to reduce negative environmental impact to also cover related spread of knowledge and research [4].

This research focuses on a course with the topic of methods for assessing transport pollution and approaches to reduce the environmental burden. The implementation of this course involves organizations from Finland and Russia, and it is targeted to university students as well as professionals from both countries. The teaching staff consists of scholars and experts involved with the mentioned subject. The course is carried out remotely via online learning environment, due to travel restrictions caused by the pandemic and to allow higher accessibility for participants from different countries, life situations and backgrounds [5–8]. Hence, this research focuses on answering the following questions:

- **RQ1:** How should the remote course involving different organizations and nationalities be designed?
- **RQ2:** What are the immediate and possible future benefits of implementing the proposed type of remote learning course?

This article proceeds by reviewing the relevant literature on benefits and challenges associated with remote learning in Sect. 2. Thereafter, the proposed course design is presented in Sect. 3, succeeded by the expected results of the course implementation in Sect. 4. Discussion reflecting the course design decisions with the established literature as well as conclusions for this study with outlook on future steps regarding the remote course implementation are presented in Sect. 5.

## 2 Remote Collaborative Learning

Da Silva et al. [9] raise concerns regarding student interaction and degree of involvement when implementing a course in a full remote manner. While pedagogy remains as the central element to enable efficient education, in the case of remote
learning the level of technology must offer adequate support [10]. Lakhal et al. [6] assign a high cost for technology and connection-related issues in remote teaching. Especially, during special circumstances, such as social distancing to mitigate spread of COVID-19, servers for remote meetings are under extended stress, which could quite possibly cause connection issues. In online teaching environment, perceived isolation and lack of interaction could undermine the students’ learning capabilities [6]. Glukhikh and Norina [11], as well as Ramsey et al. [12] note that video lectures lack informal aspects of interaction present during a physical class. This in turn could lead to suppressed development of professional communication skills. In addition, video lectures limit the communication through facial expressions and body language [2]. Furthermore, courses implemented online reduce the possibilities for improvised development decisions regarding the upcoming lesson made on the fly by the teacher [10]. However, Raes et al. [13] showcase a study, where the teacher could successfully use their existing methods of communication in a remote setting.

In their research, Lakhal et al. [6] establish conditions for successfully implementing remote learning. These conditions consist of appropriate selection of supporting technologies and tools (e.g., experience shows that sound quality is one of the key factors). Using proper equipment for delivering the education and employing technical support personnel is another requisite. In addition, adapting the selected technologies and tools through testing and practice, recording the online sessions for further use, complementing the online synchronous sessions with asynchronous communication (e.g., message boards, wikipages and email), mixing different educational approaches and strategies, and limiting student population in the remote setting (less than 25 participants is proposed as an optimal). In correspondence to the special learning conditions caused by the COVID-19 pandemic, Bao [2] composes six instructional strategies to promote online learning in a case study about Peking University. Strategies include preparing for unexpected technical difficulties (e.g., with Internet connection), separating the course content to shorter modules (length of 25 min is proposed), and emphasizing the manner in which voice is used due to the lack of other aspects of communication. Also, teaching assistants should be more closely involved to the process, focus of the course should be on the independent learning outside of the online class, and the online and offline studies need to be effectively mixed (e.g., through assignments and additional materials). Raes et al. [13] raise the importance of effectively using quizzes during remote classes to boost students’ learning motivation.

Several main points in establishing successful remote learning can be deduced from the findings of the abovementioned scholars. In short, used technical equipment and solutions should be carefully considered, the teaching should be arranged with those tools in mind, the interaction with the participants must be actively established, and asynchronous communication and additional offline materials are required to complement the online sessions. In addition, the role of teacher in higher education should shift from traditional to more represent a facilitator of independent learning for the students [11]. Moreover, in those disciplines where it is appropriate, remote laboratories improve the educational quality of a remote course [14]. While these types of laboratories are being utilized increasingly, some avoid them due to relatively high costs and low interest from potential participants to justify those costs [7].
A successful implementation of remote learning could bring various benefits for the providers of education (e.g., universities) as well as to the students. Offering remote learning enhances the flexibility and accessibility of the studies [5–8]. This in turn could increase attractiveness of the study programs offered by a university [7]. Remote setting also offers a pathway for collaboration between industries and universities, where students can learn from challenges faced by companies in practice [15]. While the current situation forces, the wide emerge of remote learning possibilities, in future the already established remote courses could be repurposed as blended courses (introducing present and remote learners to the same class). Such courses with blended synchronous learning can be utilized to mitigate the shortcomings in interactivity of pure remote learning [16]. In addition, blended learning promotes accessibility of courses by enabling simultaneous learning on-site and in other locations [17], e.g., during travel restrictions.

3 Course Design

The remote course will be offered to students from Finnish and Russian Universities in the area spanning from Southeast Finland to Northwest Russia (St. Petersburg). In addition, professionals from these regions, who are interested in the theme, are welcome to participate. Since the participants form a group of people from different countries, the course will be held in English. Common language is important to promote collaborative learning and interaction throughout the course. As the course is still being piloted, it is not a part of any study program and can be regarded as elective. Despite being implemented for the first time and not being a compulsory course to any study program in university, number of university students and local professionals have already enrolled to participate.

The purpose of the course is to showcase methods for assessing road transport emissions and approaches to reduce the environmental burden of road transport activities. The course offers the participants basic knowledge on key properties and processes in atmosphere. These will be applied to create understanding on the influence of meteorological factors to the spread of emissions in living areas and in the vicinity of highways. In addition, methods and means for measuring anthropogenic pollution and reducing environmental safety risks. Through these methods, the participant will be able to assess the risks of road transport emissions to environment and human health. Moreover, the assessment of environmental impact of road transportation will be learned through real life scenarios, which require use of openly accessible data via internet. The course will introduce the participants to different types of data needed in the environmental assessment and where this data can be gathered openly by anyone.

The remote setting of the course will combine synchronous and asynchronous communication to ensure achievement of the established learning goals. The synchronous part of the course will be delivered in form of remote lectures, that include classical lecturing on the topic but also group work, assignments and related discussion. Asynchronous part of the communication will be established through course message boards, where the participants can communicate with each other or with the
course organizers. Furthermore, video lectures will be available on the course website to support the individual learning.

As a prerequisite, the participants of the course are required to study a book on emission calculation and assessment methods written by the organizers. The book will introduce the reader to the topic of this course and offer means to perform environmental impact assessment of road transport on their own. In addition to the book, the course will be supported by additional learning materials which consist of peer-reviewed journal articles, other texts and books, and learning material made by the organizers. The repository for the learning materials on the course website can be seen in Fig. 1. Unfortunately, the main web page for the course (which contains the video lectures and the assignments) is still under construction and cannot be showcased in this article. Throughout the course, at the end of each subtopic, the participants must answer to an online test on the content of the respective subtopic. These are completed in form of quizzes, as recommended by Raes et al. [13].

The composition of the teaching group for this course includes Finnish and Russian specialists with diverse experiences and backgrounds. Therefore, the course is based on combined knowledge in road transportation technology, business and management, economics, sustainability studies, and meteorology of the organizers. This cross-disciplinary setting enables problem-oriented learning from the common topic of road traffic emissions. The course is constructed from seven separate modules (presented in Table 1), each of which contribute on the common goal of solving environmental sustainability issues in road traffic. The modules contain learning of modeling and calculation techniques, emission impact assessment and best practices in emissions mitigation.
As Walder [8] states, assessment is one of the most important aspects in providing education. Through assessment, continuous improvement of education can be achieved. Hence, the proposed course will include feedback gathering from the participants in the form of survey and free form discussion at the end. The feedback will concern three topics: quality of teaching, success of the remote setting and the adequateness of the course material and content. Despite all the educational innovation and employed technology, quality of the teaching remains as cornerstone for successful education [10], which is why it is vital aspect to measure. As setting up remote learning environment requires technological solutions, the success in this area should be monitored also. Those results can be in turn used to evaluate the further needs for technological improvement, and to include only the needed solutions in the mix, as proposed by Lakhal et al. [6]. Lastly, as the theme of the course is subject to constant development through research, best practices and regulatory action, the course content and offered materials need to remain up to date. Therefore, it is important to measure the content via feedback, especially since the mixed group of participants can voice their opinion from the perspective of both theory and practice. This data will also help the organizers to improve their book on emission calculation and environmental impact assessment.

The course will be held for the first time in the autumn of 2020, and quite possibly social distancing and travel restrictions caused by the COVID-19 pandemic are still in place by that time. Hence, the course will be held completely in a remote setting. As uncertainty lingers over the possible start of contact learning at universities, the course might be run remotely for several times. Moreover, international travel could remain restricted even after universities open their doors, which would create a demand for blended learning environments. Such environment could be one where participants gather in their local university and the course is ran remotely between these universities, allowing collaboration face-to-face on site as well as between the remote locations.

| Topic                                      | Subtopic                                                                 | Number of classes |
|---------------------------------------------|--------------------------------------------------------------------------|-------------------|
| Weather, climate and traffic pollution      | The influence of meteorological conditions on the spread of anthropogenic pollution | 2                 |
|                                             | Devices and methods for assessing anthropogenic pollution                 | 4                 |
|                                             | Estimating direct air quality emissions of the road transport and air quality dispersion modeling | 2                 |
| Risks of environmental and transport safety | Road traffic emissions calculation and analysis                           | 2                 |
|                                             | The main directions of reducing the negative impact of the road transport on the environment | 2                 |
|                                             | Using weather information to improve road safety                          | 2                 |
|                                             | Road weather forecast as a tool to increase road transport safety          | 2                 |

Table 1. Learning modules of the proposed remote course.

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4 Expected Results

As mentioned, the course will be held for the first time in the autumn 2020. Hence, the current work has been dedicated on designing and preparing the course according to the documented best practices in the scientific literature. In addition, the long spanning experience and expertise of the members in the organizing group has been consulted extensively in this phase. It is important to define expected results in order to establish measurement and development procedures, and to subsequently enable sound process of continuous improvement. In this section of the article, expected results are drawn based on the competences of the organizing group and the typical challenges in establishing a remote course.

Since the facilities used to create the remote learning setting are up to date and tested regularly, most probably the bottleneck in delivering the education remotely will be in the participant side equipment (computers and their audiovisual capabilities) and in the interface between these (internet connection). Since the course at hand is implemented by multiple organizations from locations with different standards for, e.g., software in education, the remote setting is implemented with using only the most general tools (Microsoft Office package, Skype and similar software) and placing the materials on a website run by these organizations. This approach further limits some of the problems that specific software could create in terms of compatibility. Therefore, the technological set up and performance of the remote setting is expected to be optimal.

As established, the organizing group consists of experts in various fields from both academic and professional backgrounds. The group also possesses vast amount of experience regarding education, be it in the higher education or professional setting. Hence, the quality of teaching can be expected to be of high level. Of course, it is important to regard the challenges that multicultural and cross-disciplinary setting brings to any educational event. The lecturers must be able to deliver their lecture in a language that is common for the group, i.e., English in this case. Furthermore, since the course employs multiple different disciplines, it is highly important to define common terminology and concepts, and make sure that these are used correctly in the intercourse.

The topic of this course is extremely relevant in the contemporary world, which leads to constant research, development, cultural and technological change as well as growing number of observations, conclusions and differing opinions. Thus, courses focused on environmental challenges of modern world must practice continuous improvement to keep up and stay relevant. In other words, the described operational environment requires the course material and topics to be excellent in quality, significance and originality. Therefore, the quality of the educational content seems to be the most critical point for the success of the course. It is difficult to estimate how the course will perform in this aspect for the first time, but the expertise of the organizing group should guarantee adequate course content in the mentioned qualities.

As the course focuses on environmental sustainability of road transport, it is quite fitting to also evaluate the sustainability of the course in terms of transport involved (e.g., required travelling). As pointed out by Roy et al. [3] and Caird and Roy [4],
remote courses can significantly reduce the stress on environment created by higher education. Measuring the environmental sustainability of the course at hand also creates an excellent case study for the participants.

5 Concluding Discussions

This article focuses in designing a remote course delivering cross-disciplinary knowledge and education for a mixed group of student and professionals. The work was completed by following the frameworks of Lakhal et al. [6] and Bao [2], and by employing the experience of the scholars in the organizing group. This approach led to identifying three critical points for the success of this remote course. First and foremost, the level of education and pedagogy remains vital in implementing any course. In the case of modern higher education and remote courses, the teacher should act more as a facilitator for independent study, than as a lecturer [11]. The mix of technologies used in the remote setting must be then selected in order to complement the pedagogical competences of the teacher. In addition, it is recommendable to select only the amount of different technologies that is truly needed. Lastly, the provided content within the course should be relevant. The adequateness of the content seems to be the most critical point in success for this course. Therefore, extended attention has been given to the course content, which includes a book on the course topic written by the organizers, video lectures and additional readings. Also, as suggested by Raes et al. [13], the course is complemented with quizzes in between the subtopics to engage the participants more. The communication in this course is carried out both synchronously (during the online classes) and asynchronously (via message boards).

As the course is piloting a setting that is currently not very common, the importance of feedback and research to enable improvement is high. After the first run, lots of room for development will probably remain. The organizers must be ready to improve all the measured aspects of the course. Especially the course content can be expected to be subject to constant improvement due to the nature of the course topic. Therefore, the continuous improvement of the course requires predictive work by the organizers in addition to regarding the course feedback.

If successful, such remote courses as the one described in this article could enhance the flexibility and accessibility of the studies in the involved universities [5–8]. This is important benefit for modern universities, as it could increase the attractiveness towards new students [7] in the world where competition in higher education is dire. In addition, a course which welcomes professional participants also enables universities to more effectively solve societal and business practice challenges [15].

Similarly as described by Pisoni [15], after the current special conditions ease up (e.g., universities open their doors, travel restrictions start to be lifted) remote implementation offers a pathway to continue interorganizational collaboration via synchronous online classes, where the physical class is situated in one of the partner institutes and other participants may join via online. At the same time potential for extending the course to other institutions could be recognized (i.e., appreciation from the voluntary participants). In this case, the course could act as a bridge for extended collaboration between Finnish and Russian higher education institutes. This type of
development would be desired, as it enables continuous longitudinal development of this particular course, as well as addition of new courses or even creation of a specific program revolving around road traffic emissions. Nowadays, even the implementation of fully remote or blended university program is not out of the question [12].

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