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From Synchronous Face-to-Face Group Work to Asynchronous Individual Work: Pivoting an Enterprise Modelling Course for Teaching during a COVID-19 Lockdown

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Abstract:

This paper outlines the challenges faced in a particular instance of an enterprise modelling (EM) course that lost the ability to have face-to-face interactions and describes a solution that proved to be at least equally effective and appreciated when moved online. The revised course design is primarily driven by exercise and assignment work, provides course content in a 'piecemeal' fashion, and relies almost exclusively on asynchronous interactions. This paper distils the solution into specific design features of the revised course as well as more general design principles that can be applied to other EM courses (and potentially beyond).

Keywords: Enterprise modelling, Asynchronous teaching, Flipped classroom.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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1 Background

Enterprise Modelling (EM) courses are a staple of Information Systems (IS) programmes as well as many IS majors in business and computer science programmes (Eduglopedia, 2020). EM courses go by different names and typically focus on business process, systems, or enterprise architecture (EA) analysis, modelling, and design. Typical learning objectives for such courses include attaining modelling proficiency in selected modelling language(s) (for instance, BPMN, UML, or ArchiMate).

Emphasising 'hands-on' activities for students helps achieving these learning objectives. These activities can range from more traditional weekly practical exercises in small tutorials that accompany a lecture to large-scale flipped classroom approaches where the classrooms – any large-scale lecture hall settings as well as the smaller tutorial settings – function as 'modelling studios' for the better part of the course (Tanner & Scott, 2015). In these 'modelling studio' settings, close face-to-face interactions between the teaching staff (the lecturer as well as the tutors) and the students are a cornerstone for attaining the learning objectives. These interactions comprise, for instance, giving quick answers to students' modelling-related questions that have arisen during homework or ongoing exercises, or offering feedback – solicited and unsolicited – to students' draft diagrams or ongoing work that are visible on paper or computer screens.

As conversations on how to best model a given scenario are helpful on the learning journey – and play a crucial role in practice as well (Hoppenbrouwers, 2012) – placing the students in groups can be another integral component of such courses to give them a 'forum' for those conversations. To achieve a match between learning objectives and assignments, the assignments are often also of a practical nature and may comprise individual and/or group work.

The author has been teaching an EM course on EA modelling across two programmes for three years and – based on the student submissions, final grade distributions and teaching evaluations of the most recent course offering that was not affected by COVID-19 – has finally achieved a course design that was both effective and appreciated. As highlighted in the next section, the initial course design relies heavily on weekly synchronous face-to-face interactions in two ways: between students for their EA modelling effort to collaboratively produce 'one EA diagram at a time', and between the students and the teaching staff for questions & feedback. The transfer of the course into the virtual space due to a strict multi-week (and initially open-ended) country-wide lockdown due to the COVID-19 situation removed both opportunities for interaction.

To document the challenge of and the chosen solution to re-tooling the course, this paper draws on the design science research[1] trifecta of *design requirements, principles and features* as an established means to codify design knowledge (Drechsler & Hevner, 2018; Meth et al., 2015; vom Brocke et al., 2020), extended by the necessary course *redesign actions*. In a nutshell, the design features implement the design requirements in order to achieve the solution, and the design principles provide actionable knowledge on a more general level than the usually very context-specific design features. How the resulting design features of the revised course as well as the more general design principles can be applied to other EM courses (and potentially beyond, where similar requirements apply) will be revisited in the final section.

2 The Pre-COVID Course Setting and the Resulting Challenge

The core part of the course follows the four main TOGAF layers (vision, business architecture, IS architecture, technology architecture) (The Open Group, 2019). The course's three main EM-related assignment deliverables comprise a baseline architecture report, a target architecture report, and an architecture transition & governance (t&g) report for a chosen scenario of a given fictional enterprise. The students work in groups on the baseline architecture; the target and t&g report were individual or group work (depending on the programme where the course was offered). If the latter two were individual work, all group members receive the same mark for the baseline report. In the other case, the group members have to indicate which parts of the three reports they were accountable for and are individually assessed based on their contribution. A complementary peer-assessment for each group member could affect their marks in case of attempts at 'free-riding'.

[1] The Simonian design science approach (Simon, 1996) is also applicable to teaching and course design (Laurillard, 2013).

The core part of the course is comprised of weekly face-to-face 'EA modelling studios' (a 90 min lecture + 50 min tutorials in one programme, a 240 min block in the other programme) where the students are briefly introduced to and immediately start working in small groups on a number of EA diagrams (one after the other) from the 'TOGAF layer of the week'. During the lecture time, the tutors are around in the classroom as well to help the lecturer offer immediate assistance to students in case of questions or give feedback based on the draft diagrams on the students' screens or overheard conversations. Bevor the next diagram is introduced, students can share draft versions with the lecturer through private message in a Slack room so that the draft can be shown anonymously to the entire classroom along with verbal feedback. The tutorials (if they exist, see above) are run basically in the same fashion, just with a smaller number of students and a single tutor. For each week, the students are asked to prepare one or two TOGAF catalogues (lists of potential elements to model) for the respective layer so that they can begin their group work during the 'modelling studio time' right away. At the end of the week, everyone submits their week's draft diagrams in their current state, along with a brief reflection and a brief indication of their own contributions to the week's group effort of producing the draft diagrams. In a further refined form, these draft diagrams would then become part of a coherent baseline architecture report. Besides the lecture slides, there is also a written EA Guide with one page per diagram to support the students' EA modelling efforts.

Since the shift to the virtual space took place during the trimester – with a few weeks of a break – and given the wide range of possible individual circumstances it would have been unreasonable to expect the students to continue effective weekly synchronous collaboration through virtual (and self-organised) means in order to produce an essential assignment deliverable. And even if it were, there would be no opportunity to seek quick answers & feedback from the teaching staff – taking away the 'modelling studio' atmosphere. Against this backdrop, the design requirements for a course redesign outlined in Table 1 were formulated.

Table 1. Design requirements and their justification

Design Requirement	**Rationale**
DR1: Offer a learning arrangement that balances regular engagement with the course material with the range of the students' possible individual circumstances during the lockdown	The overall goal for the redesign was to re-create the existing 'dynamic' of the weekly 'modelling studio' approach as best as possible in the virtual space. One key aspect of the modelling studio approach is regular hands-on engagement with the course material (= EA modelling) each week. Simultaneously, only few assumptions could be made about the students' individual circumstances so the revised course had to take this into account as well.
DR2: Offer a means to seek quick answers & feedback from the teaching staff	A second component of the weekly modelling studio approach are frequent interactions with the teaching staff (lecturer and tutors). These interactions comprise feedback to modelling outcomes (diagrams etc.) but also questions and answers. The course redesign therefore should enable these interactions to take place in the virtual space instead of a lecture or seminar room.
DR3: Offer optional means for collaboration & conversation between students	A third component of the modelling studio approach is student collaboration in the same small groups within lectures and tutorials and for the first big assignment (the baseline architecture report). While finding the time and the means for regular virtual collaboration could not be expected for everyone, there should be nevertheless the option for such interactions to occur during the study process.
DR4: Keep the technical barrier for virtual engagement low	This requirement focuses specifically on the technical dimension of the students' circumstances in which they had to take the course during the lockdown phase – not only to account for potentially limits to technical means (e.g. stability of the internet connection) but also for the absence of the possibility to solve a technical issue with a 'quick look over their

	shoulder'.

3 The Solution: Course Design Principles, Features & Redesign Actions

This section outlines the developed solution to the challenge described above. Figure 1 shows the design requirements, principles and features – which focus on achieving the eventual outcome / the solution – in rectangles with square corners. In contrast, the redesign actions focus on the journey towards the outcome and are distinguished in Figure 1 by being shown in rectangles with round corners. The subsequent sections highlight in greater detail how the (re)design actions (DA) informed the new design features (DF) that realize the design principles (DP) in order to meet the design requirements (DR) from Table 1.

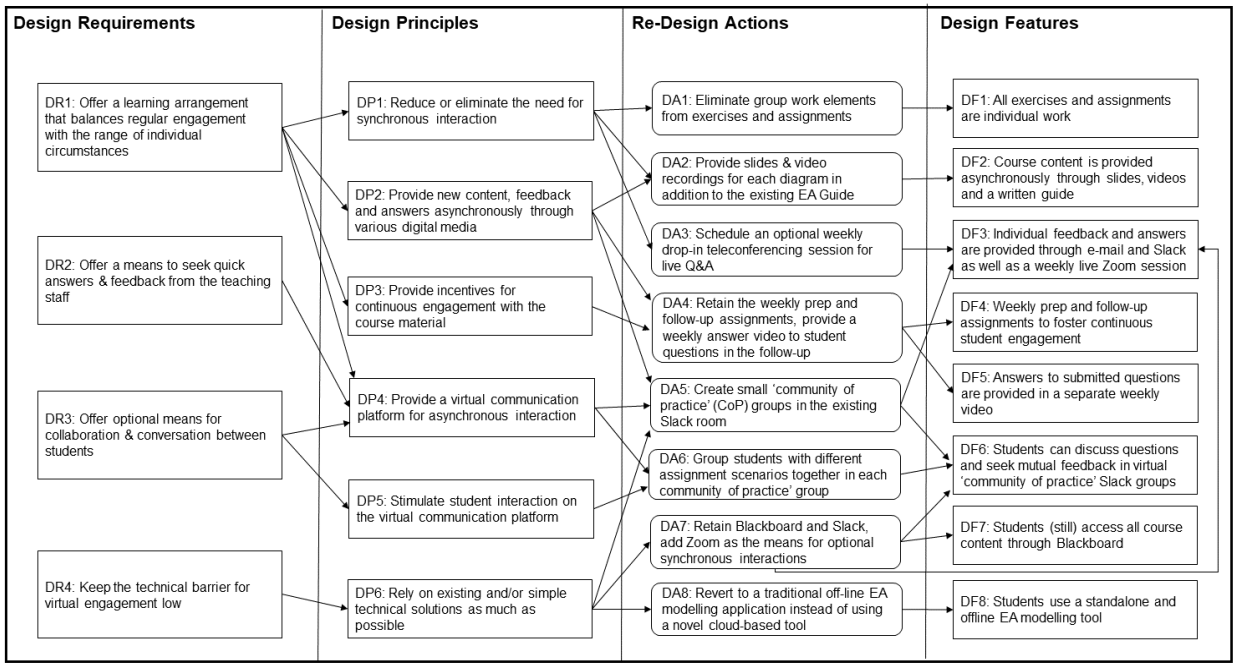

Figure 1. Design requirements, principles, features and corresponding redesign actions

3.1 DP1 and DP2: From synchronous face-to-face asynchronous virtual interactions

In a nutshell, an effective solution to the presented teaching challenge lay in radically changing (DA2-DA4) the course delivery mode from weekly synchronous face-to-face interactions to a fully asynchronous delivery (DF2-DF5) with all group work being eliminated (DA1) in favour of individual work (DF1). Hybrid approaches were considered but there was no obvious purpose that a weekly virtual synchronous lecture or discussion-focused session could serve that the provision of video commentary on the slides and the asynchronous interaction could not serve with more flexibility for everyone involved. Note that there were no restrictions on the side of the university with respect to the extent of synchronous or asynchronous interactions in courses, hence a fully asynchronous mode was an option.

In particular, the 'TOGAF layer of the week' rhythm was retained. Introductory videos for each diagram replaced (DA2) the short lecture-style introductions to new diagrams that would have taken place during the 'modelling studios'. In addition, a weekly 'answer video' to the questions submitted in the weekly follow-up assignments was posted (DA4). These videos were supported by the existing written material (slides & guide, DF2).

An optional weekly Zoom drop-in session for live Q&A was added (DA3) after two weeks upon student request, adding to the variety of channels used for interactions and engagement (DF3). Zoom was chosen as it was the university-wide standard tool for virtual lectures and meetings.

3.2 DP3: Small weekly assignments instead of weekly lectures drive the course forward

The existing assignment arrangements were not changed except for adjusting the submission deadlines and removing (DA1) all group work aspects and requirements. In the past, the assignment arrangements have proven to be effective in assessing whether the students have reached the course learning objectives, and those objectives did not change. Moreover, the otherwise unchanged weekly preparation and follow-up assignments actually proved to be surprisingly adept at supporting the students' continuous engagement with the course material (DF4). Students could also choose to ask questions in their follow-up submissions; a video with all questions and answers was posted a few days later (DF5).

3.3 DP4 and DP5: Support the asynchronous virtual interaction with a suitable platform

The designated main platform for asynchronous interaction was a Slack room which had been designated before merely as a means for students to share their draft diagrams for feedback during and outside the 'modelling studio' sessions. This Slack room was now given the additional purpose to give quick answers and feedback to students who could post text as well as images of their EA diagram drafts (DF3).

To re-create a 'small group feel' – but one where interaction was optional – each student was placed (DA5) in a community-of-practice (CoP) Slack channel with three or four other students and a member of the teaching staff (DF6). The term was used since it is not uncommon for enterprise architects in practice to be part of a CoP in an organisation (Horlach et al., 2020). Slack was chosen a few years ago mainly due to the overall simplicity and its effectiveness in a traditional classroom setting when accessed through a variety of devices. For their assignment work, every student could pick one of four scenarios in the fictional enterprise used in the course. We assigned (DA6) students to CoPs so that everyone in the same CoP works on a different scenario. This enables everyone to freely share draft diagrams in a CoP without giving away possible relevant assignment solutions.

3.4 DP6: Keep the technological barriers to participation low

The slides, videos, and the EA Guide PDF were available through the established learning management system (Blackboard) (DF7) and the existing Slack room's purpose was merely expanded. The only new tool that was introduced (DA7) was Zoom for the optional weekly drop-in sessions (DF3). Slack runs in the browser and has mobile apps as well, so the technical barriers for engagement were kept low (→ DR4).

Originally, the plan had been to use a novel cloud-based EA modelling tool (Stratamap) to support collaborative EA modelling, but since there was no group work anymore, the decision was made to revert (DA8) to a stand-alone application (Archi) as in the years before (DF8). Archi has a lower complexity than Stratamap and also does not require a stable internet connection while modelling.

3.5 Assessing the design feature effectiveness

Table 2 summarises to which extent the design features managed to meet the initial design requirements and also shows the relations between design features, design principles (mentioned in brackets in the first column) and requirements (mentioned in the second column).

Table 2. Design features and their effectiveness

Design Feature	Assessment
DF1: All exercises and assignments are individual work (DP1)	This design feature proved effective implementing DR1 since a considerable number of students submitted regular preparation and follow-up deliverables as well as very detailed and polished baseline, target and t&g architecture reports.
DF2: Course content is provided asynchronously through slides, videos and a written guide (DP1, DP2)	This design feature also proved effective implementing DR1 based on the high-quality assignment work that was handed in based on the provided content and the type of questions that was asked about the content (see also DF1 above and DF3 below).

	However, based on slightly different 'styles' in some of the examples used in the video & the slides on the one hand and the EA Guide on the other hand, it was also obvious there were a number of students who followed one or the other, but not both.
DF3: Individual feedback and answers are provided through e-mail and Slack as well as a weekly live video session (DP1, DP2, DP4)	This design feature also proved effective implementing DR1 and DR2 since especially Slack was utilised well by many students – either by posting in 'their' CoP Slack channel or by sending private Slack messages to 'their' assigned member of the teaching staff (or 'senior architect' as we called ourselves). E-mail and the optional weekly live video Q&A session were lesser utilized channels. Many questions demonstrated an already deep understanding of course content, and there were only a few where the answers could have been found in the slides, videos, or the EA Guide.
DF4: Weekly prep and follow-up assignments to foster continuous student engagement (DP2, DP3)	This design feature also proved to be effective implementing DR1, see DF1 above. Moreover, a few students mentioned in passing that the weekly follow-up assignment enabled them to focus on the coursework even in challenging personal circumstances.
DF5: Answers to submitted questions are provided in a separate weekly video (DP2, DP3)	This design feature proved to be quite effective implementing DR1, although the viewership of the answer videos was about half that of the other 'regular' content videos.
DF6: Students can discuss questions and seek mutual feedback in virtual 'community of practice' Slack groups (DP2, DP4, DP5)	This design feature contributed to an effective implementation of DR1 and DR2 (see DF3 above) but in the end ineffective to implement DR3. There were little to no visible interactions between students in the CoP channels, and there were several CoPs with only one person out of three or four visibly active in the channel (many preferred direct messages to their 'senior architect'). While it was a deliberate design decision not to incentivise interactions in the CoPs (since this would penalise those students in more challenging circumstances) there needs to be specific attention how this can be achieved in the future.
DF7: Students (still) access all course content through Blackboard (DP6)	This design feature proved to be overall effective implementing DR4, although a few students initially had issues in finding all necessary information on Blackboard. While all Blackboard courses across the school have a similar general structure, the way how each course coordinator had adapted 'their' rooms to the new setting was quite different and thus sometimes a challenge for students to navigate.
DF8: Students use a standalone and offline EA modelling tool (DP6)	This design feature also proved to be effective implementing DR4 since there were hardly any issues reported regarding the use of the Archi tool.

4 Discussion

Overall, the revised course design (i.e. the set of implemented design features) proved to be both effective in reaching the learning objectives and appreciated by the majority of students who filled out the optional course and teaching evaluations.

The course's effectiveness can be inferred from the absolute pass rate (94%), the percentage of A+ grades (31%, up from 16% last year) or the median grade (A-, unchanged from last year). Compared to the previous offering, there were higher highs (e.g., the A+ grade percentages) but also lower lows (15%

vs. 10% C+/C/C- grades and a 2% lower pass rate) in terms of assignment submission quality. Subjectively, the two key factors influencing student performance were a) the amount of time and focus they were able to devote to coursework during and after the country-wide lockdown and b) the extent to which they were able to pivot alongside with the course delivery and utilise the opportunities to seek answers and feedback in the Slack CoP groups or in the optional weekly drop-in session.

That the course was also appreciated is reflected in the course evaluation scores that were higher than last year's offering in the same programme (2.2 vs. 2.5 overall course evaluation on a scale of 1-5, 1 being best), but lower than the previous offering in the other programme (1.6) which had taken place under 'normal' circumstances. The course was also explicitly mentioned as a positive example in an informal survey of all undergraduate IS courses offered during the lockdown trimester conducted by the school. Moreover, a few students mentioned in passing that the asynchronous and 'piecemeal' provision of content (e.g. one short video per EA diagram) and the weekly follow-up assignment enabled them to focus on the coursework even in challenging personal circumstances. The course evaluations also noted a high course workload – but this may be as much an issue with the inherent complexity of EA as it is with the general course design.

One side-effect of the revised course, however, was a weekly workload for the teaching staff that was at least differently distributed and more unpredictable than having weekly lectures and tutorials scheduled at fixed times and perhaps the odd question coming in per e-mail over the week. Since every member of the teaching staff (one lecturer, two tutors) essentially took care of a third of the course in 'their' CoPs, we all could have interactions with students at 'any time' during the week whenever someone posted a Slack message and we saw them on any of our devices. The amount of incoming messages fluctuated, depending on the perceived difficulty of a week's diagrams or the closeness of a submission deadline. In addition, there was the regular weekly work of marking everyone's preparation and follow-up submissions. While this work would have been there in the previous course design as well, we strived to have the marks and feedback ready after only a few days to inform everyone's ongoing work on the new EA diagrams and the baseline architecture report. The time to prepare the weekly videos was at least equal to the time that would have been spent in the classroom, and the weekly Zoom drop-in session and the answer video to the questions in the follow-up came on top.

5 Lessons Learned & Outlook

As design or actionable knowledge – such as the design principles and features covered in this paper – is usually dependent on a specific context to be regarded as useful (or fit-for-purpose), there is a tradeoff between this utility (or fitness) of the knowledge on the one hand and the projectability of the knowledge into different contexts on the other hand (Baskerville & Pries-Heje, 2019; vom Brocke et al., 2020). Therefore, there has to be a differentiated treatment of the lessons learned that are to be derived from the specific context that the design principles and features were developed for: a mid-term transition for an EM course from a synchronous face-to-face to an asynchronously and virtually delivered course.

Table 3 discusses for each design principle the corresponding implications of projecting it into other contexts. These other contexts comprise, for instance, other EM courses than EA modelling, other practical IS courses (e.g., programming) and other IS or even higher education courses in general that do not take place in a traditional face-to-face setting. As design principles represent more abstract knowledge than design features, Table 3 focuses on the design principles.

Table 3. ***Projectability of the design principles into other teaching contexts8***

Design principle	**Implications for a projection into other contexts**
DP1: Reduce or eliminate the need for synchronous interaction	Among the design principles, this is the arguably the most context specific principle as it is the only one that deals with the transitional aspect of the context. For future applications outside of mid-term course redesigns, a more general principle could be to find the most appropriate balance of synchronous and asynchronous interactions between teachers and students as well as between students (e.g., group work) for a given teaching situation and the intended learning objectives and course content.

	For more practically-minded courses, a strong practical exercise and assignment focus can become the main driver to move the course forward, regardless whether there are regularly scheduled synchronous meeting points (i.e. lectures and tutorials).
DP2: Provide new content, feedback and answers asynchronously through various digital media	For an asynchronous mode (which may be complementary to or replacing synchronous content provisions and interactions, see the row above), offering course content on multiple media (e.g., slides, video, written guide) allows students to choose their favourite format but leads to extra effort on the side of the teaching staff. In case of asynchronous video content provision, one important note is that it cannot be expected that everyone will have watched every video. Therefore, it is useful to convey important messages through one (or more) separate channels with more guaranteed attention. In other words, it makes sense not to 'bury' course organisation announcements or assignment hints among the slides or videos as you would perhaps do in a regular course at the beginning of each session with a 'housekeeping' slide. In a long-term perspective, and especially with the creation of videos, re-usability of course material becomes a much more crucial issue. For instance, it can be useful to make extra efforts to make future video recordings 'timeless' – for instance, by removing references to the year or current events.
DP3: Provide incentives for a continuous engagement with the course material	This is arguably the most widely applicable design principle among the six. In the course discussed in the paper, the small weekly preparation and follow-up assignments for a few marks were actually carried over from a face-to-face offering of the course. In both cases, they contributed to everyone staying on the ball throughout the course. The weekly follow-up assignments also provided an alternative avenue for feedback and questions. For the asynchronous course delivery mode, however, such an assignment structure may be even more important as it helps students to choose a useful pace to proceed with the exercises. An asynchronous mode relies much more on everyone's self-organisation skills than a traditional weekly lecture & tutorial format. This applies to investing the necessary amount of modelling time each week, but also to not investing more time than necessary and 'gold plate' assignment submissions (which has happened in a few cases). To combat the latter and communicate our expectations for the assignments, we tried to establish the mantra 'copper, not gold' (England & Vu, 2019) throughout the course.
DP4: Provide a virtual communication platform for asynchronous interaction	This is a rather straightforward design principle – if the outcome of the more general decision about the extent of asynchronous interaction (see DP1 above) is that there will be one, then there needs to be a platform where these interactions can happen.
DP5: Stimulate student interaction on the virtual communication platform	As the case of this course illustrated, just providing a technical platform for asynchronous interaction is not sufficient. Achieving regular virtual interactions among students require specific incentives – this was the major requirement (DR3) that remained largely unfulfilled. Hence, no more specific suggestions can be given at this point on how to achieve this.
DP6: Rely on existing and/or simple technical solutions as much as possible	This design principle is even more context-independent than DP4 – the technical platforms chosen for all purposes (e.g. content provision, interactions, assessment etc.) should not interfere or present barriers for the engagement with the material or other pedagogical purposes.

Beyond the design principles and the teaching-related considerations, this paper is one of the few DSR papers the author is aware of that concern a *re*design effort instead of a newly created design. Hence, the consideration of *(re)design actions* in addition to the trifecta of design requirements, principles and features is – to the author's best knowledge – a novel methodological contribution to the DSR discourse. It allows an additional emphasis on the (re)design journey in addition to the emphasis on the outcome. Such insights may also be helpful to inform future (re)design efforts.

The biggest remaining challenge for future course offerings – as the discussion for the first and fifth design principle in Table 3 hints at – will be the re-introduction of regular and effective weekly distributed group work. This should be easier to achieve when the asynchronous and virtual nature of the course is known to everyone in advance, and everyone has become more familiar with the distributed nature of university study. The criteria for group formation can reflect the new situation – e.g. to form groups around those times of the day where every group member can schedule regular virtual interactions in lieu of attending regular weekly classes. The expectations for such regular virtual collaboration can also be communicated clearly at the start of the course, training and support in effective virtual collaboration can be given, and the peer-assessment criteria for the group work can also be tailored accordingly. Also, the originally envisioned cloud-based EA modelling tool (Stratamap) can be very helpful for such an environment so that virtual collaboration in EM does not become an exercise in answering the question 'what is the most recent file version and who has it?'

To conclude, the presented course design led to a quite effective and appreciated EM course offering. Hopefully, the design principles, redesign actions, and features discussed in this paper can be helpful to inspire the redesign of other IS courses in general or EM courses in particular for a post-COVID world.

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