

COVID-19 FORCED REMOTE TEACHING AND UNIVERSITY EDUCATION AFTER IT

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ABSTRACT

The COVID-19 outbreak at the beginning of 2020 disrupted students' and teachers' learning and teaching activities worldwide as it led to a quick transition from education, including face-to-face interaction to emergency remote teaching (ERT). During this ERT period monitoring research on the experiences and innovation needs was done at Wageningen University & Research. This was supplemented with small teacher and student group consultations. The results show that a focus on student well-being is needed in the years ahead. The ERT was appreciated as it kept education going on. Still, students indicated lack of sense of connectedness and a strong desire to have face-to-face education as part of the Teaching and Learning Activities (TLA). For the following years, online versions of most courses should be available to stay prepared for online education when needed. That includes online alternatives for vulnerable TLA's like labs and excursions. The ERT courses hastily developed in 2020 can be redesigned in combination with a blended learning curriculum for less restricted times. This requires a well-designed mix of TLA's to activate students, rather than simply flipping one kind of TLA for another. In combination with the (re)design of courses geared to sense of connectedness, this might add up to the resilient curricula we need for the following years.

KEYWORDS

Emergency remote teaching, well-being, online & face-to-face learning, education design, resilient curricula, CDIO standards: 6, 7, 8, 10.

INTRODUCTION

The COVID-19 outbreak at the beginning of 2020 disrupted students' and teachers' learning and teaching activities worldwide. It led to a quick transition from regular higher education, including face-to-face interaction, to emergency remote teaching (ERT) (Hodges et al., 2020). Crawford et al. (2020) describe the initial responses to COVID-19 in higher education across 20 countries. The actions up to March 2020 ranged from having no response through to social isolation strategies on campus and rapid curriculum redevelopment for fully online offerings. In March 2020, most European higher education institutions were implementing a response plan to the COVID-19 outbreak or developing one (Rumbley, 2020). Gaebel et al. (2021) surveyed 368 education institutions from 48 European Higher Education Area countries. They found that in April 2020, practically all of those institutions managed to pivot to blended and online learning. They also found that the rapid shift to ERT was possible due to a much higher acceptance of digitally enhanced learning and teaching in 2020 compared to 2014. This shift also happened at Wageningen University & Research (WUR). During that ERT, research was designed to monitor the transition process in education by examining the perceptions of relevant stakeholders such as teachers and students. That research consisted of (1) large scale student and teachers surveys (Stevens et al., 2020a, 2020b), (2) a small in-depth teacher survey on requested innovation (van Puffelen & Tauecchio, 2021) and (3) online student and teachers consultations. This paper combines all these results to draw conclusions on the design needed for university education in the years ahead.

METHODS

The pandemic came as a surprise, and the research was planned after the ERT had already started. There was no comparable situation in the past, and a mix of quantitative (surveys) and qualitative research (interviews) was chosen to explore the new situation.

Teacher survey

All teachers involved in teaching or coordinating a course from March till July 2020 (the ERT period) were invited by email to partake in an online survey. They were informed about the study and the option to fill in the survey anonymously by leaving some items blank. Participants were first asked if they spent at least 6 hours teaching in the given period to validate a minimum active role in the teaching period. In total, 289 teachers (21%) participated in the survey. Teachers were asked to indicate their age, gender and role: 'course coordinator' (responsible for the course and involved in many teaching activities) or 'lecturer' (teaching a part of a course). An analysis of the characteristics of the respondents indicated a representative sample of the teacher population at WUR in terms of age ($N = 112$, $M = 45$, $SD = 11.26$), gender ($N = 157$, 54% male, 46% female) and teaching role ($N = 272$, 60% lecturers, 40% coordinators). The survey included questions about teachers' attitudes towards online teaching, beliefs about students' learning, stress level, digital and didactic self-efficacy, their professional development and the perceived level of support. For each construct variable, we used multiple items with a 5-points answering scale (mostly Likert scales ranging from 'strongly

disagree' to *strongly agree*'). The percentage of teachers that agreed or strongly agreed with a given statement was calculated to indicate the general support for a statement. In addition, teachers were asked about the use of and satisfaction with education support services (11 items), teacher training (11 items), and online teaching tools (39 items). The use of a service (support, training, or tool) was measured as 'yes' or 'no', and overall use was established into a variable based on the total 'frequency of use' for each type of service. Finally, the evaluation of a support service, teacher training and online teaching tool was measured on a 5-point satisfaction scale. The variables, items, their mean and standard deviations are shown in tables 1 and 2. The reliability measures were satisfactory.

Table 1. Statistics of construct variables

	<i>N</i> cases	<i>N</i> Items	<i>M</i>	<i>SD</i>	<i>Cronbach's Alpha</i>
Attitude towards online teaching	287	3	3.53	0.83	.65
Beliefs about students' learning	269	5	2.43	0.58	.76
Experienced level of stress	287	3	3.73	0.93	.70
Self-efficacy	286	2	3.82	0.77	.64
Beliefs about professional development	286	3	3.65	0.81	.67
Perceived level of support	287	4	4.01	0.72	.74

Table 2. Statistics of variables

Variable	<i>N</i> cases	<i>N</i> items	Item options	<i>M</i>	<i>SD</i>
Use of (participation in) teacher trainings	288	11	binary yes/no	1.42	1.61
Satisfaction about teacher trainings	189	11	5 point satisfaction scale	3.66	0.90
Use of support services	288	11	binary yes/no	4.05	2.54
Satisfaction about support services	259	11	5 point satisfaction scale	3.47	0.87
Use of on-line tools	288	39	binary yes/no	6.96	4.02
Satisfaction about online tool	275	39	5 point satisfaction scale	3.58	0.76

Student survey

From March till July 2020 (the ERT period), questions about student perceptions of online education were included in the student course evaluations (3850 responses out of 14.150 students in 207 courses) and collected through an additional student survey that focussed solely on online education (1251 responses). An analysis of the respondents of the student course evaluations indicated a representative sample of the student population at WUR in terms of age, gender, nationality and study program. However, in the survey about online education, female students, Dutch students, and first-year students were overrepresented. The survey included questions that covered the themes: student services; experiences and evaluation of online education; well-being; self-perceived learning performance; the use and experience of new tools for online teaching; the experience of new learning activities and forms of assessment (e.g., virtual lectures, group work, proctored exams).

Teacher survey about future education innovation

These surveys were supplemented with a small-scale in-depth survey on requested topics for future education innovation at WUR. A small group (21) of education staff subscribed to innovation news was asked to respond to an anonymous online survey, and this option was also offered on a WUR intranet website. The questions were about their opinion on required education innovations and about the importance of five education innovation topics that were considered important in internal discussions of the four Dutch technical universities:

1. Entrepreneurial learning/academic entrepreneurship
2. Educating for responsible engineering/the ethical or responsible engineer
3. Information technology and the information technology-driven engineer
4. Challenge-based learning
5. Teaching excellence in education

They could score each topic's importance on a 5-point Likert scale: 1: Not at all important, 2: Slightly important, 3: Moderately important, 4: Very important, 5: Extremely important. Also, there was an option to give free-text feedback on each topic.

Consultation of small groups of students and teachers

A team dedicated to working with small groups of students and teachers to gather different education experiences at WUR, organised online sessions on ERT-related topics between July 2020 and June 2021. These topics were requested by WUR's management and education support staff and included 'Following a Course Online' (July 2020, 8 students), 'Blended and Hybrid Education' (November 2020, 18 students), 'Teaching During Corona' (February 2021, 6 teachers) and 'Alternatives for Practical Education' (June 2021, 7 students). The sessions aimed to find potentially successful areas to improve education during and after the ERT. Outcomes were used to inform workgroups and policy-makers at WUR. A design thinking approach was used, including making a shared inventory and prioritisation, identifying underlying needs and tackling the main issues in small groups by creating new designs. The online setup of the process is shown in figure 1.

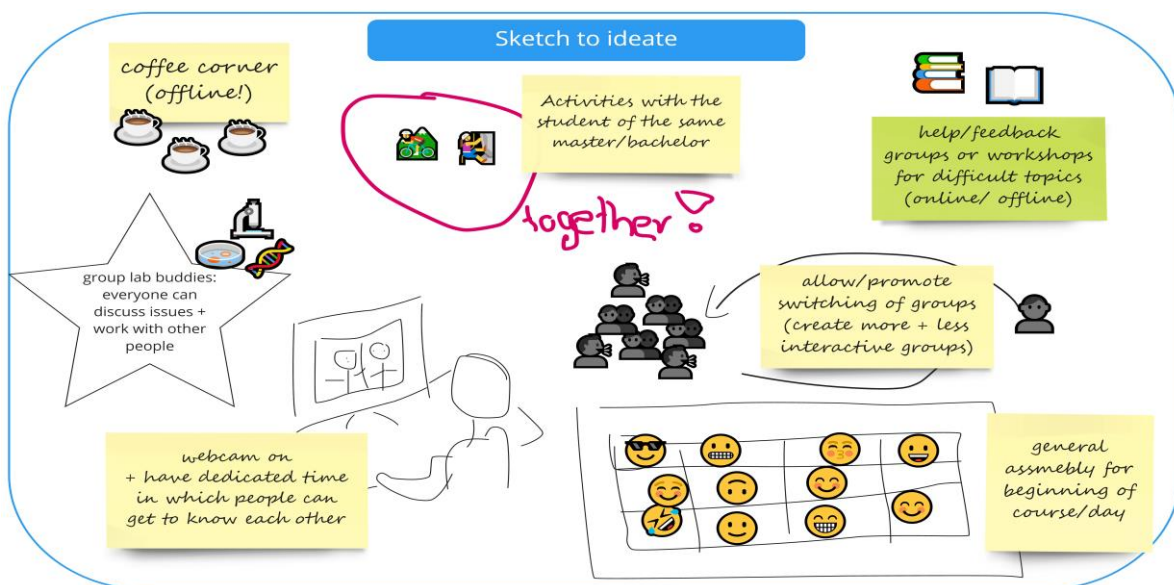


Figure 1. Student group's ideation process during online consultation.

The student sessions were about their experience of the transition to online education: aspects that worked well or didn't work well; the main difficulties and (unexpected) opportunities; effects on learning goals, motivation, focus, feeling of connection and commitment; expectations of teachers' and students' roles. The teacher session was on their lessons learned during ERT, focusing on positive aspects; what they would like to maintain or improve for future teaching; and how they would optimise their course(s) if they could redesign it completely. As these sessions were meant exploratory, thematic content analysis with basic inductive coding was used to process the input given during the sessions (Green & Thorogood, 2018). Both Dutch (58%) and international students (42%) participated in the three student sessions. This means a slight overrepresentation of international students, who comprise around 22% of the total student population at WUR between 2019 and 2022. Most of the participants were master students (74% versus bachelor students, 26%). Among the international participants, male and female students were represented alike (46% male vs 54% female), while most Dutch participants were female (17% male vs 83% female). The session with teachers included mostly Dutch (83%) and female participants (83%).

RESULTS

Teacher experiences

The results of the teacher survey showed that teachers experienced stress (66%), difficulties working from home (51%) and an increased workload (80%)¹. Teachers spent 43.8% more time on teaching during ERT than during pre-covid times. The increased workload was frequently mentioned as a key concern in the open comment section of the survey. Few teachers liked online teaching (29%), but most were motivated to teach online (74%). Teachers felt they had the digital skills (83%) and didactic skills (59%) to teach online. Overall, they felt they managed to teach their course online successfully (85%). Taken together, teachers experienced an increase in workload but were still motivated to teach online and felt they were able to teach their courses online successfully.

Student experiences

Students felt supported by teachers and the university, and they were satisfied with the services (student support, IT, communication). However, most students indicated they were not motivated to study online (69%). Students found it difficult to combine personal life at home with online education, and they experienced various physical and mental problems such as feelings of loneliness and stress. In the open comment section of the survey, they indicated that they particularly missed personal contact. Personal contact was considered essential for their well-being and learning (discussing course content, freely exchanging thoughts, learning from others) and creating a sense of community (connecting). In contrast to teachers, students did not experience a significant increase in their workload. Few students 'liked' online education. These results show that the motivation of students to study was low and that they experienced physical and mental problems during ERT.

Learning performance

Both students and teachers indicated that students' learning performance in complete online education was worse compared with (partial) on-campus education. The feedback of teachers

¹ The percentage of research participants that agreed or strongly agreed with the statement

to students, the collaborative learning among students, the motivation of students, and the engagement of students were all considered lower in online education, both by students and teachers. However, grades were slightly higher, and course satisfaction was comparable with pre-covid times. Thus, there seems to be a discrepancy between teachers' and students' general beliefs about the effectiveness of online education, students' performance (grades), course satisfaction, and self-perceived learning.

Online Teaching Methods

The survey results showed that many online tools and teaching methods were used by teachers for the first time, such as Virtual Classroom, Microsoft Teams, and Zoom. Teaching methods were often being revised rather than just maintained or entirely replaced. Most teachers intended to maintain some changes in teaching methods (despite the overall negative attitude towards online education). Students differed in evaluating different learning activities and new online teaching methods. This could indicate that there is no single 'best method' for online teaching and that to cater for different types of students, it is essential to combine different online teaching methods.

Future education innovation survey

The response to the small future education innovation survey was limited to 17 persons. Therefore, statistical analyses were not carried out, but the free-text responses yielded valuable ideas consistent with the scores. The ideas on innovation projects, workshops and training needed for the years ahead emphasised finding new approaches in blended learning with vital roles for on-campus and face-to-face interaction. The five presented topics were recognised as important with some differences. "Teaching excellence in education" and "educating for responsible engineering/the ethical or responsible engineer" were seen as very to extremely important. "Information technology and the information technology-driven engineer" received the most positive comments on the "IT for learning" subtopic. The responses on the "IT skills" were mixed. "Challenge-based learning" was seen as a good idea, but there were concerns that it would result in not enough time for training academic skills and take too much time from teachers. "Entrepreneurial learning/ academic entrepreneurship" received support for education and students' future, but there were concerns like being less relevant for the first years of BSc and taking away too much time for training academic skills.

Consultations

The student consultations yielded the following observations:

- Students viewed the lack of social contact and difficulty of online interaction as a main issue: contact and interaction were intertwined with meeting their learning goals, maintaining motivation, and feeling supported. Interaction was also seen as essential to feel part of the WUR community and create a solid professional and social network.
- Students experienced the benefits of having more time and flexibility of online education. However, having more time and flexibility also affected their attitude and mindset. While this provided an opportunity for balance and growth (self-reliance, self-starting) in some cases, it also led to a lack of motivation and limited progress in other cases.
- Students missed being able to use all senses during online alternatives to practical education and felt this affected their ability to learn. Also, enrichment of content, e.g., through knowledge clips in preparation for a practical, might help to learn more effectively.
- Working in smaller groups, facilitating peer support, and variation in educational tools and methods might help address the need for improved, more direct interaction. Mentioned

examples were small Q&A sessions as part of the course, small group discussions, informal (real-life) breaks, online interactive tools for group work, and dedicated time to get to know their fellow students.

- Students experienced improved motivation and mental health during blended education versus complete online education.

The online consultation of the teacher group indicated that they:

- Saw positive aspects of working with online tools during ERT but needed more time and support to learn to work with these tools properly.
- Stressed the importance of student interaction but felt that it was difficult to realise it online; it might help to let students ask questions less publicly; the barrier to asking questions will even be lower than offline, which might result in improved student engagement.
- Felt that it is essential to work together as a group and learn from each other, being able to divide tasks can help with that.
- Learned what worked well by asking low-barrier feedback from students.

DISCUSSION AND CONCLUSIONS

The large-scale teacher and student surveys

Teachers and students struggled with the sudden move to online education. Teachers did so mainly because of the increased workload during ERT, and students suffered from a lack of motivation and a decline in well-being due to the lack of face-to-face interactions. Although both teachers and students showed a negative attitude towards online education in general, they were positive about specific pedagogical adaptations (online teaching and learning methods) and their performance. Their negative attitude towards online education should thus be interpreted in light of the sudden involuntary move to the online world and the broader societal context. The discrepancy between teachers' and students' general beliefs about the effectiveness of online education and students' performance (grades) may also be explained by this. An overall negative affective attitude can influence beliefs about effectiveness. ERT is an externally forced change that diminishes feelings of voluntariness and autonomy and impacts motivation and attitudes. Providing the conditions to experience autonomy (giving choices), competence (positive performance feedback, optimal teacher support services), and relatedness (collaborative learning and innovation, solidarity) can help to increase intrinsic motivation and mitigate stress.

Future education innovation survey

In general, teaching staff saw options for more online education than pre-pandemic. But they stress the importance of face to face and campus education. That is not much different from pre-pandemic opinions, as van Puffelen, van Berkum, and Diederer (2018) described. The ideas on more online education are generally not about merely flipping the classroom by exchanging two forms of Teaching and Learning Activities (TLA's). Most ideas in the survey responses require optimising the complete combination of TLA's geared towards higher learning goals and more active and personalised learning. This can be achieved by selecting TLA's on their characteristics towards a type of learning and creating a smart design using (many) kinds of TLA's as described by van Puffelen (2017). In the years before the pandemic, the reported education innovation at WUR was more on the course than on the program level (van Puffelen & Vonk, 2020). In 2020, the pandemic shift towards online education could only

be done by quick changes on the course level (course: a unit of teaching typically lasting no longer than one academic term). That might still be on the responders' minds as most remarks were at the course level. But there were remarks at program level as well (program: all courses required for a degree), mainly on learning goals at the program level for the skills needed in the future. The ideas for those learning goals differ amongst the respondents. Some feel that the recent introduction of more general skills education has already caused less focus on academic skills and the connection between research and education. Others see a need to focus more on other skills, including IT and a value-creating mindset seen with challenged based and entrepreneurial education. In general, there seems to be a need for a new balance and integrated plan for all types of skills mentioned above. That could also be seen as a follow-up on the vision of education (Wageningen University, 2017).

Consultations of small groups of students and teachers

The consultations showed that students and teachers preferred some face-to-face interaction. But if that becomes limited due to new Forced Remote Teaching, the advice offered under results "consultations" provides education design guidelines that improve the situation.

Combining the results

In general, the three surveys and the consultations did not lead to contradicting results, but they show differences in aspects of common topics:

- the well-being of teachers and students
- appreciation of the ERT
- education design for the years after the ERT

These topics are discussed below.

The well-being of teachers and students

Teachers experienced an increase in workload but were still motivated to teach online and felt they could teach their courses online successfully. The well-being of students was low during the ERT. This is also reflected in mental health survey amongst 28.000 higher education students in the Netherlands in spring 2021 (Dopmeijer et al., 2021). At that time, there was closure of the hospitality sector, a nationwide curfew and ERT. Around half of all students (51%) had psychological complaints, such as feelings of anxiety and sadness. Of this group, 12% had serious complaints. Their mental well-being was out of balance. They also found that students experienced significant levels of stress, performance pressure and sleeping problems. The survey questions did not separate the general effects of the pandemic from the impact of online education. The strong general restrictions on life (like curfews), worries about health and relatives, and extreme online life during the ERT period caused severe stress for many. Student rooms are often small, which is ok as long as students spend much of their time outside of them. But during curfew and lockdown, small rooms might feel like prison cells. This is even more a problem for students being outside their home country as they have no option to temporarily move to parents or relatives. Questions on well-being and appreciation of education during the pandemic might measure that effect combined with the impact caused by the shift in education. In addition, there might be an interaction between these two effects: for instance, the forced general online life adding up to the online education work stress. Also, some students left their university towns to study online from other places. But even before the pandemic, there were quite some well-being issues amongst higher education students in the Netherlands (Dopmeijer et al., 2021), and new periods of forced remote teaching might be ahead of us. So, a clear focus on student well-being is needed in the years ahead.

Appreciation of the ERT

The ERT enabled education to go on, and that was appreciated. And it helped that there had been face-to-face education before the ERT. Nevertheless, the students indicated lack of sense of connectedness and a strong desire to have face-to-face education as part of the Teaching and Learning Activities.

Education design for the years after the ERT

In 2020, ERT saved higher education from being completely stopped. Now, face-to-face education is possible again in many countries, but sometimes with restrictions. The battle with new virus mutants will continue in the following years, and the potential for new outbreaks remains (Mostafavi et al., 2022). So, it is wise to stay prepared for 100% online education when needed. This requires focusing on the well-being, sense of connectedness of students and staff and having online versions of most courses available. The experience with ERT is valuable for that, and we can now try to integrate the ERT online courses into our blended learning curriculum for less restricted time. That will reduce maintenance costs compared to keeping separate ERT courses. This can be done using a few guidelines in mind. First, students differ in preferences towards online and other TLA's (van Puffelen, van Berkum & Diederer, 2018). A carefully designed mix of TLA's is needed to activate most students; it is not a matter of simply flipping one kind of TLA for another. Also, the combination of synchronous and asynchronous TLA's need more design time than our teachers had at the beginning of the ERT with CDIO standards (Malmqvist, Edström & Rosén, 2020) 6, 7, 8 and 10 in mind. In addition, we need to address the challenges for (partial) online alternatives regarding lab education, excursions and alternative assessment methods. In combination with the (re)design of courses geared to a sense of connectedness, this might all add up to the resilient curricula we need for the following years.

ONGOING WORK

WUR is doing follow-up research to explore students' and teachers' perceptions of and experiences with blended education in the present situation. The main research questions are: (1) What are the perceptions of students and teachers of blended education? (2) Are perceptions of students and teachers and their stress levels different compared to online education? (3) What are the experiences of students and teachers with blended education? (4) What key features of online education should be kept for blended education? Students' and teachers' surveys have been sent out, and data have been collected. The preliminary results indicate higher motivation, higher workload, and more stress for teachers in the present situation, and for students, lower stress, higher motivation, and higher workload experiences. In-depth results will be disseminated in scientific and practitioner communities. In addition, other related work will be shown as projects in the [4TU.CEE innovation map](#) (4TU.CEE, 2022) and a [project page](#) (Researchgate, 2022) about Education design for new educational challenges of universities.

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BIOGRAPHICAL INFORMATION

Emiel van Puffelen is the leader of the 4TU.Centre for Engineering Education at Wageningen University & Research. At Wageningen University, he supervised the creation and full-scale operation of the University Teaching Qualification program. He also developed MOOC production teams, knowledge clip studios, education innovation consultancy, the educational portal, and a team for the innovation of the IT learning environment. He is a senior consultant for higher education innovation and has worked for national organisations. He has a particular interest in activating learning, blended learning, training teaching staff, and the novel design of curricula and courses.

Tim Stevens is currently employed as a postdoctoral researcher at the Eindhoven School of Education, Eindhoven University of Technology. The research described in this article was carried out while working as a postdoctoral researcher at the Education and Learning Sciences group, Wageningen University and Research. Tim is an interdisciplinary scientist with expertise in media, education and the information society. His research focuses on educational innovation and teacher professional development in higher education.

Seyyed Kazem Banihashem received his PhD in Educational Technology, and he is currently employed as a postdoctoral researcher at Education and Learning Sciences Group, Wageningen University and Research. As an educational technologist, Kazem is interested in innovative use of technology in education. His research, in particular, focuses on Technology-Enhanced Learning, Learning Analytics, Learning Design, Feedback, and Argumentation.

Harm Biemans is associate professor at the Education and Learning Sciences group of Wageningen University & Research. With a background in educational psychology, he has carried out and supervised many research projects in the domains of learning and instruction, educational technology, and educational innovation. His research concentrates on competence development of (future) professionals and design and effects of corresponding learning environments and pathways in higher and vocational education.

Omid Noroozi is associate professor of educational technology at the Education and Learning Sciences group of Wageningen University & Research. He has carried out and supervised many research projects in the domains of learning and instruction, educational technology, and educational innovation. As an educational technologist, Omid is interested in innovative use of technology in education. His research focuses on Technology-Enhanced Learning, Learning Design, Feedback, and Argumentation.

Nienke Raeven is Education Experience Analyst at Wageningen University's Education & Student Affairs. She specialises in journey mapping and design thinking to understand the perspectives and needs of students and teaching staff. This provides input for the improvement of education-related processes and services. She has a background in needs assessment in International Public Health and advocates using illustration and visualisation to gain insight.

Perry den Brok is chair of the 4TU Centre for Engineering Education and chair of the Education and Learning Sciences chair group at Wageningen University and Research. He also chairs the division of Higher Education of the Netherlands Educational Research Association. He supervises the large-scale survey and interview study described in this paper. As a full professor and expert in educational innovation, he supervises several post-docs and PhD students on teaching and innovation in higher education, regularly gives keynotes and publishes many articles and other contributions. He is also one of the key persons at WUR with respect to educational innovation.

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