



# Development and validation of a students' remote learning attitude scale (RLAS) in higher education

Katerina Tzafilkou<sup>1</sup> · Maria Perifanou<sup>2</sup> · Anastasios A. Economides<sup>3</sup>

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## Abstract

Considering the distinct particularities of emergency remote education (ERE) and the urgent need for new or adjusted measurement models, this study develops and validates a multidimensional instrument to measure students' attitude towards ERE. The Remote Learning Attitude Scale (RLAS) was explored and validated on a sample of 142 students participating in fully remote teaching and learning university programmes during the covid-19 crisis, in Greece. The exploratory factor analysis clearly revealed five dimensions, and the model was evaluated through PLS-SEM confirmatory factor analysis. The study also found that the students' field of study and prior experience in distance learning cause differentiations in RLAS dimensions, while gender and age make no statistical differences. Results indicate that RLAS is a practical and effective tool for evaluating the university students' attitude towards remote as opposed to traditional teaching and learning.

**Keywords** Distance education · Emergency remote education · Online learning · Online teaching · Students' attitude scale

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✉ Katerina Tzafilkou  
katerinatza@gmail.com; tzafilkou@uom.edu.gr

Maria Perifanou  
mariaperif@gmail.com

Anastasios A. Economides  
economid@uom.gr

<sup>1</sup> SMILE Lab & Department of Economics, University of Macedonia, Egnatia 156, 54636 Thessaloniki, Greece

<sup>2</sup> SMILE Lab, University of Macedonia, Egnatia 156, 54636 Thessaloniki, Greece

<sup>3</sup> SMILE Lab, Department of Economics & Information Systems, University of Macedonia, Egnatia 156, 54636 Thessaloniki, Greece

## 1 Introduction

With the spread of the covid-19 the domain of online teaching and learning is experiencing great changes as higher-education institutions need to emergently adopt tools and practices of distance education (DE). Universities are implementing emergency plans towards the fully digital transformation of their educational modules, to assist students in smoothly adapting to this new online academic era (OECD, 2020a). The traditional face to face and/or blended learning has been in short term replaced by Emergency Remote Education (ERE) to ensure learning continuity in several countries worldwide. To face this challenge, educational institutions need to use their existing DE platforms or develop new ones, and provide teachers and students with adequate online learning opportunities (OECD, 2020a).

To efficiently achieve this transformation the availability and use of technological resources (Bozkurt et al., 2020; OECD, 2020b) might not be enough. Universities will face several issues of inequity and ‘failure’ and must develop alternatives to enhance students’ engagement towards the learning continuity (World Bank, 2020). For this, they also need to be aware of their students’ preferences and attitudes towards DE practices (Chung et al., 2020), as opposed to their so far traditional learning experiences. By examining and re-examining students’ attitudes towards distance and remote education, institutions can ease the transition for students and faculty and decide on which training modules to ‘invest’ more towards their rapid digital transformation.

This study distinguishes the usually interchangeable terms of ‘remote’ and ‘distance’ learning, focusing on the remote side, due to the covid-19 emergency situation. Contrary to DE, Remote Education (RE) is defined by the geographical separation of learners and teachers while ERE is temporal and obligatory, while distance education is an option (Bozkurt et al., 2020). Researchers agree (Bozkurt & Sharma, 2020; Hodges et al., 2020; Huang et al., 2020; Tzifopoulos, 2020) that during the covid-19 pandemic, it is a case of emergency remote education which is a branch of DE. As it is recently explained (Hodges et al., 2020) after the covid-19 crisis is over, educational institutions should not equate ERE to online learning when evaluating their applied ERE strategies.

Although there are several scales and measurement tools on students’ perceptions towards DE (e.g., Al-Malki et al., 2013; Atkinson & Blankenship, 2009, Coates, 2006; Hung et al., 2010) they mainly focus on their readiness to go online and their ability to adopt distant learning approaches, when this is an option. Recent works (e.g., Chung et al., 2020) that examine the students’ readiness to attend fully remote learning programmes due to the covid-19 situation tend to apply those previously established scales (e.g., the one developed by Hung et al., 2010). However, those previous online readiness scales have been developed in the previously generic context of DE, and although they provide a meaningful structural model they need to be further adjusted and improved (Wei & Chou, 2020). Moreover, researchers agree (Bhagat et al., 2016; Rath et al., 2019) that further research is needed to study the relationships between the students’

demographic variables and their perception towards online learning. As a fact, today there are different conditions and the dimension of ERE should be considered and explicitly analyzed.

Other studies (e.g., Brooks & Grajek, 2020) analyze the role of the students' learning environment preferences, their previous online learning experience and their device access, without though adopting an ERE adjusted or oriented measurement model. Moreover, those previously applied measures provide generic results about the broad concept of DE and not the remote transition of RE related modules, like for instance the online synchronous attendance, online communication with peers or professors, etc.

There are several other studies that measure the university students' attitude towards online learning by examining the students' attitudinal factors in terms of their technology acceptance constructs (easiness, usefulness), interest, learning capability, or online course experiences (e.g., Chen et al., 2013, 2017; Joo et al., 2018; Ullah, 2017; Zhou, 2016; Zhu et al., 2020). Similarly, their measurement models are based on previously established theories e.g., the Technology Acceptance Model-TAM (Davis, 1989), and have not been adjusted to the today's trends and/or an emergency remote education. Additionally, most of these studies have been conducted in online and blended learning (e.g., MOOCs environments) and not in fully remote university courses.

There are some other works that examine the adult learners' selection criteria of DE (e.g., Lee et al., 2019), including perceptual factors like their motivation to voluntarily enroll in online courses or open universities. However, due to the covid-19 derived digital transformation, researchers should examine different factors since young students' do not have the 'privilege' of selection or voluntary enrollment, and most university courses (both in undergraduate and postgraduate programmes) are conducted exclusively remotely.

## 1.1 Purpose of the study and innovation

Motivated by the above research gaps and the covid-19 drastic educational changes in higher education, the main objective of this study is to develop and validate a scale to measure the students' attitude towards fully and emergency remote education.

Due to the covid-19 emergency transition in all educational contexts, the proposed scale is focused on evaluating the students' perceptions towards remote education as opposed to their so far traditional blended learning experiences.

Contrary to previous works, the suggested model includes:

- (a) A set of functional remote teaching and learning components (like online synchronous attendance, online collaboration, etc.) attempting to evaluate the students' attitude towards each component and the RE as a whole;
- (b) Multidimensionality considering a set of students' attitudinal items (e.g., easiness, usefulness, control, interest etc.) to measure the functional RE components which reflect the generic construct of remote education.

This study also explores the role of student individual factors like gender, age, field of study, and previous DE experience on the distinct RE dimensions.

To sum up, this study seeks to address the following research objectives:

- (1) Develop and validate a new scale to measure students' attitude towards emergency remote in comparison to traditional learning, by defining a set of different RE components.
- (2) Examine student differentiations in the suggested RE components, according to their individual characteristics of gender, age, and previous experience in DE.

The main contribution of the suggested scale is to provide higher education institutions with an up-to date emergency, time-saving, and valid measurement model to assess their students' attitudes and perceptions towards specific RE components and RE as a whole, shedding light on the educational needs and priorities that should be considered during the process of replacing traditional with online teaching and learning.

## 2 Theoretical background

Distance education has drastically evolved from mixed (offline-online) and/or blended learning practices to fully remote settings since covid-19 has made fully online (i.e., remote) learning the common delivery method across the world.

In the first part of the section, we explain the main differences between the terms of distance, online and remote education to ease the perception of emergency remote education as a small but significant branch of DE, with distinct particularities. In the second part of this section, we present a brief literature review on recent studies that examined university student's attitude during the covid-19 ERE situation in different regions, but also in earlier times regarding the broader concepts of DE and online teaching and learning. In the end we summarize the main attitudinal attributes that have been included in the recent relative studies.

### 2.1 Distance and emergency remote education

During the past years, various authors and researchers have used inconsistently the terms distance and online education. Traditionally, DE refers to the exploitation of online teaching methods and tools, alone or in a combined/blended learning mode (UNESCO, 2020), mainly reflecting a pedagogical concept (Moore, 1997, p. 22) and not a fully remote situation. Today it is well defined that distance education does not specifically refer to online education, but to a wide range of technologies used in teaching and learning (Bozkurt et al., 2020). Distance education is agreed to include all the ICT and Internet based learning and teaching practices, like online learning, e-learning and mobile learning, as well as remote education and learning (Bozkurt et al., 2020).

Online learning or online education is a critical component of Distance Education (Davis, 1989) that provides learning resources to facilitate interactions and knowledge sharing (Jogezai et al., 2021). Online learning refers to educational activities conducted solely via Internet (Allen et al., 2016). Recently Hodges et al. (2020) explained that online learning is based on pedagogical design principles adopted through the Internet.

Today, most educational institutions provide their students with blended learning that is a mixture of online technology enhanced learning and face-to-face experience (McGarry et al., 2015). According to the definition of Staker and Horn (2012, p.3) blended learning is “a formal education programme in which a student learns at least in part through online delivery of content and instruction ... and at least in part at a supervised brick-and-mortar location away from home” (p. 3). In this study we consider blended education as ‘traditional/usual’ education, because of the huge explosion of blended learning in the recent years, as described in the recent review work of Anthony et al. (2020).

On the other side, remote education (RE) is another branch of DE that cannot be combined with traditional learning since it is defined by the geographical separation of the individuals (Bozkurt et al., 2020). This restriction is its main differentiation from online learning, since the latter is frequently combined with blending learning activities. Remote education has recently faced a remarkable evolution even before the covid-19 crisis, mainly due to the numerous online course offerings, and the increasing number of adult learners entering or returning to open universities (Lee et al., 2019).

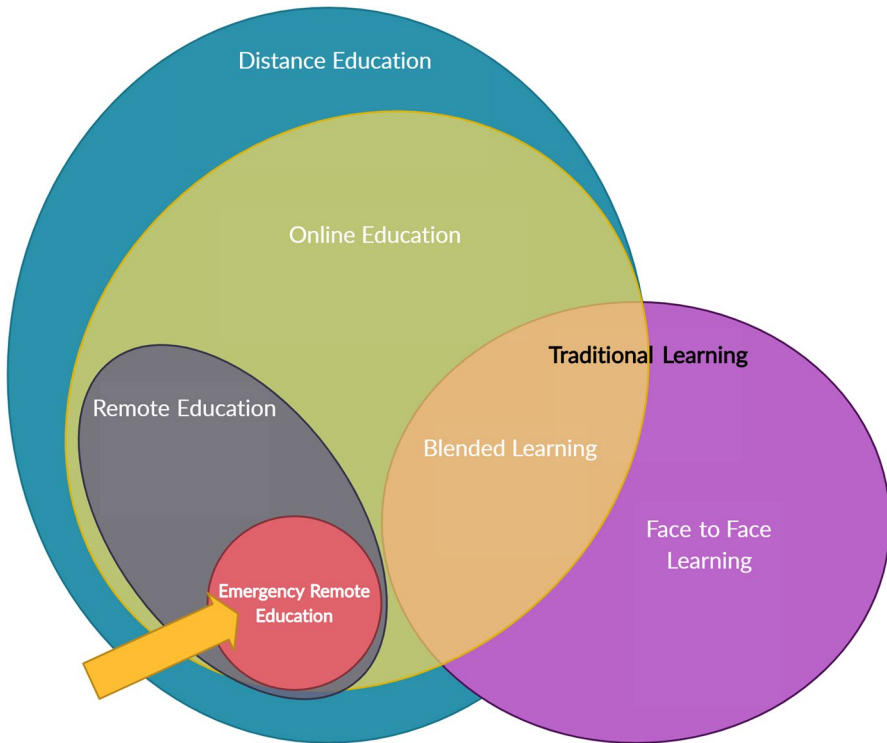
The term of emergency remote education (ERE) mainly reflects the obligatory nature of geographically remote education under the scope of the covid-19 social distancing situation, where students do not have the option to attend classes in a traditional learning mode. Moreover, ERE is a temporal situation triggered by some sort of crisis and is aimed to replace in short term all previous online, blended, and face-to-face activities (Hodges et al., 2020).

ERE is considered a far more complex phenomenon than DE, since its universal adoption and effectiveness are too fragile and prone to failure (as noted by the World Bank, 2020). It is also worth to mention that ERE highly depends not only on technology or digital infrastructure, but also on a set of behavioural, attitudinal, and socio-psychological attributes that seem to have affected the whole educational community including teachers, students, and parents (Bozkurt et al., 2020).

Figure 1 distinguishes the educational terms used in the current study, defining the place of ERE in the broader context of DE.

## 2.2 Measuring students’ attitude towards distance and emergency remote education

Attitude is generally defined as the sensation or opinion regarding a specific issue (Ayub, 2017; Binder & Niderle, 2007), and it can be positive, negative or neutral. Student attitude towards ICT reflects the students’ perceptions and beliefs about the ICT integration in teaching and learning practices, and is dependent on



**Fig. 1** The emergency remote education as a small branch of distance education

several individual characteristics as well as their prior technological experience (Binder & Nierdele, 2007). In most studies attitude is composed of three dimensions: cognitive, affective, and behavioral (Guillén-Gómez et al., 2020).

To evaluate the students' attitude and ability to adopt DE and online learning several previous works developed and validated scales to measure the students' readiness (in terms of positive attitude) to participate in distance and online education (e.g., Atkinson & Blankenship, 2009; Bernard et al., 2004; Coates, 2006). Those models mainly considered the factors of students' preferences on the distance as opposed to the face-to-face learning mode, the students' computer or Internet related self-efficacy, and their ability to self-regulation, that is to engage in autonomous and self-controlled learning.

Building on those past models Hung et al. (2010) developed the popular Online Readiness Scale (ORLS), composed of five dimensions: i) self-directed learning, ii) motivation for learning, iii) computer/Internet self-efficacy, iv) learner control, and v) online communication self-efficacy.

Recent works that seek to examine students' readiness to adopt fully remote learning due to the covid-19 pandemic usually exploit previous scales (e.g., the one of Hung et al., 2010) and examine a set of other influential factors like demographics, students' online learning experiences, their intention to continue using

online learning, access devices, preferences, etc. (Brooks & Grajek, 2020; Chung et al., 2020).

In a research study on students' acceptance of ERE during covid-19, Aguilera-Hermida (2020) examined the factors of student motivation, self-efficacy and previous use of technology concluding on their significant influence on students' acceptance of remote learning. Her findings on 270 students in Penn State Harrisburg University (U.S.A.) revealed that most students preferred the face-to-face education highlighting the great need for further exploration of the factors that affect students' readiness and acceptance to adopt RE.

Mishra et al. (2020) studied the perceptions of teachers and students about online teaching and learning during the covid-19 pandemic in India. The authors applied semi-structured interviews to investigate the participants' opinions regarding the institutional or personal technology resources and their learning/teaching experience, resulting in the confirmation of the difficulties they face to efficiently achieve an ERE transition.

Tzivinikou et al. (2020) examined a set of attitudes towards DE during covid-19 in a sample of special education teachers in Greece. Their 10-item scale examined two DE dimensions regarding efficacy of DE and difficulties related to DE. As the authors suggest, this simple new scale can be easily used in order to measure the effectiveness and the quality of the emerged distance education programs in order to take rapid decisions during the covid-19 crisis.

In a research conducted in Sweden (Bergdahl & Nouri, 2020) examining the schools' and teachers' preparedness, the authors found that teachers lack pedagogical strategies that are essential in the ERE transition.

Several more studies have been conducted in the context of medical education during the covid-19 crisis, mainly because of the clinical rotation cancelation and the closure of laboratories (Anwar et al., 2020). For instance, Manalo et al. (2020) evaluated the efficiency of an emergency virtual course on urology, by examining the students' interest, understanding, and perceptions of urology as a specialty and the utility of the remote course. Their findings revealed that most of the students expressed an increased interest; however, many students reported no change or decreased interest towards the course. Interestingly most students achieved higher performance score in an exam session after having participated in the remote course. In a similar attempt, Samueli et al. (2020) evaluated the successfulness of a covid-19 emergency remote course of pathology on undergraduate medical students in Israel. Their distance learning practices included remote labs, interactive slide interfaces and the instructors encouraging the students for discussion and further interaction. Their mixed qualitative-quantitative results indicated high scores of students' engagement, satisfaction, and perceived usefulness of the learning format revealing that rich and well-design online material can achieve the students' positive attitude towards ERE modules. However, most of the studies into medical education context conduct their surveys on limited or small sample sizes -9 students in the work of Manalo et al. (2020) and 59 students in the work of Samueli et al. (2020)- mainly because of the small-size medical labs and specialties.

In the context of the covid-19 psychological consequences, Hasan and Bao (2020) studied the psychological effects of covid-19 "e-learning crack-up". The

authors applied the Kessler psychological distress scale (Andrews & Slade, 2001) on a sample of 400 higher education students in Bangladesh, concluding that fear of academic year loss highly affects the psychological distress of students' during covid-19.

There a few more works focused on examining the impact of covid-19 crisis on college and university students and professors' mental health in terms of anxiety, depression and emotional self-efficacy (Besser et al., 2020; Chen et al., 2020).

Overall, the above-mentioned studies revealed significant outcomes that should not be neglected by the research community and educational institutions towards the design of their ERE-transition strategies. However, most of the cited studies have been conducted in specific educational contexts (e.g., pathology course) and bring several limitations (e.g., students' representation and sample size). Therefore, ERE strategies and factors that affect remote course performance should be further examined in different educational contexts and in larger populations.

### 2.2.1 Attitudinal attributes of DE/RE explored in higher education

Apart from the online readiness measures, researchers have been continuously attempting to measure the students' attitude towards DE and online learning by applying a set of previously well-established theories, like the Technology Acceptance Model (TAM), (Davis, 1989), the task-technology fit theory (Aljukhadar et al., 2014), the self-efficacy theory (Bandura, 1977), the self-determination theory (Ryan & Deci, 2000), etc. To quantify the students' attitude, those studies (e.g., Chen et al., 2017; Joo et al., 2018; Romero Martínez et al., 2020; Ullah et al., 2017; Zhou, 2016; Zhu et al., 2020) examined various behavioral and cognitive characteristics of the students, like perceived usefulness, ease of use, interest, attention/engagement, enjoyment, satisfaction, motivation, self-regulation and their intention to continue online learning.

Table 1 selectively summarizes the attitudinal attributes that have been examined by recent works on university students' attitude and readiness towards DE and online learning.

In summary, reviewing the relevant research about university students' attitude towards distance education highlights a need to: (a) examine those attitudes in the context of fully remote and/or emergency remote education and (b) establish new measurement scales and models adjusted to the fully and/or emergency remote situation.

## 3 Methods

### 3.1 Sample and procedure

This study was conducted on a sample of undergraduate and postgraduate university students in Greece who attended distance lectures during the covid-19 social distancing measures, from March to June 2020. An online questionnaire using Google Forms was sent out via emails and the e-learning platform notification



**Table 1** University students' attitudinal attributes for distance and remote learning

Attitudinal attribute	Study
Perceived ease of use, Perceived usefulness	Chang et al. (2017); Guo et al. (2016); Ifinedo (2018); Romero Martínez et al. (2020); Ullah et al. (2017)
Enjoyment, satisfaction	Abdous (2019); Guo et al. (2016); Joo et al. (2018); Mohammadi (2015); Mouakket (2015); Tarhini et al. (2015)
Interaction, collaboration, communication, support	Chou et al. (2015); Chung et al. (2020); Cole and Timmerman (2015); Dağhan and Akkoyunlu (2016); Guo et al. (2016); Huang et al. (2017); Lee et al. (2016); Mohammadi (2015); Tanis (2020); Zhu et al. (2020)
Self-regulation/self-control	Alhamami (2018); Ifinedo (2020); Joo et al. (2018); Lee et al. (2016); Tsai et al. (2018); Zhou (2016); Zhu et al. (2020)
Interest and engagement	Manalo et al. (2020); Ullah et al. (2017); Samuelli et al. (2020); Tsai et al. (2018)
Anxiety	Abdous (2019); Hsiao et al. (2017); Lee et al. (2016); Paul and Glassman (2017)
Motivation	Chen et al. (2017); Chou et al. (2015); Kim et al. (2017); Ifinedo (2020); Aguilera-Hermida (2020); Zhou (2016)
Demographics, prior DE experience	Abdous (2019); Chung et al. (2020); Hacheyet al. (2015); Aguilera-Hermida (2020)

system to a total of 320 students enrolled in the bachelor programme of Economics and in the master programmes of Information Systems, Digital Marketing, and Law and Finance, in two different universities. All programme courses were conducted in a (fully) remote teaching and learning mode with a hybrid of synchronous and asynchronous format. The students participating in the international postgraduate programme of Digital Marketing ( $N=26$ ) attended all RE lectures through the Zoom platform, while all the other students ( $N=116$ ) used the Google Meet platform. The Moodle e-learning platform was used for the asynchronous part by all students.

Finally, 142 students (87 undergraduate and 55 postgraduate) completed the questionnaire. A set of socio-demographic characteristics was collected through the first part of the survey. As presented in Table 2, most of the participants were undergraduate students in the field of Economics, most students (70%) did not have any previous experience in distance learning/education, and they spend on average 2.7 h/day on their computers.

The questionnaire was provided in Greek language to the 116 students enrolled in one university, and in English language to the 26 students enrolled in the second university attending the international postgraduate programme of Digital Marketing. The programme is taught exclusively in English language and supports optional DE for those students who need/wish to study remotely (mainly due to geographic allocation, lack of transportation or else). In the sample there was only two foreign

**Table 2** Participants socio-demographic characteristics ( $N=116$ )

Gender	<i>n</i> %	Age	<i>n</i> %	Study Programme	<i>n</i> %	Previous experience in distance learning)	<i>n</i> %	Computer use daily frequency	<i>n</i> %
Female	62.7%	18–24	51.4%	Economics (Under graduate)	87%	Yes	30%	< 1 h	12.07%
Male	36.6%	25–30	34.5%	Information Systems (Postgraduate)	11%	No	70%	1–3 h	29.6%
N/A	0.7%	31–36	8.5%	Digital Marketing	17%			4–6 h	33.1%
		37–45	2.1%	Law & Economics (Postgraduate)	–			> 7 h	24.6%
		46+	1.4%	Undefined					

students (Netherlands, Tunisia), and six distant Greek students living in different countries (Germany, Spain) or cities.

All participants were asked to consent for their anonymous participation and were informed about the purpose of the survey and the utility of their feedback. Before proceeding to the questionnaire items regarding their attitudes towards remote teaching and learning approaches, participants were provided with the following terminology to assist them in homogeneously perceive the definitions of ‘usual’ (traditional or classic) versus ‘remote’ teaching and learning.

- **Usual (classic / traditional) Teaching & Learning**=the teacher teaches simultaneously with physical presence in the classroom and/or by using technology (e.g., PowerPoint presentations, computer lab, software applications), and asynchronously using Internet (e.g., email, Learning Management System (moodle, eclass, compus), sharing on cloud (google drive, dropbox), educational resources on Internet). Today, in most lectures the teaching and learning method is Blended and not exclusively Face-to-Face (F2F) as it used to be.
- **Remote Teaching & Learning**=the teacher teaches synchronously and asynchronously only via the Internet. Teaching, communication, homework, educational materials, etc. are exclusively performed via the Internet.

### 3.2 Selection and design of the scale components

The quantification of the RLAS was accomplished based on the qualitative exploration of DE and online learning concepts and measures derived from the literature review. The item generation was conducted with the guidance of the literature review of previous research and measures on students’ attitudes and readiness for online learning. The item of flexibility was integrated (although it has not been broadly studied in the context of distance learning) mainly because of its important role in remote education environments according to recent studies (Zayabalaradjane, 2020) showing that flexible learning and learner-centered approaches can make learning outcomes useful and exciting in emergency situations like the covid-19 pandemic.

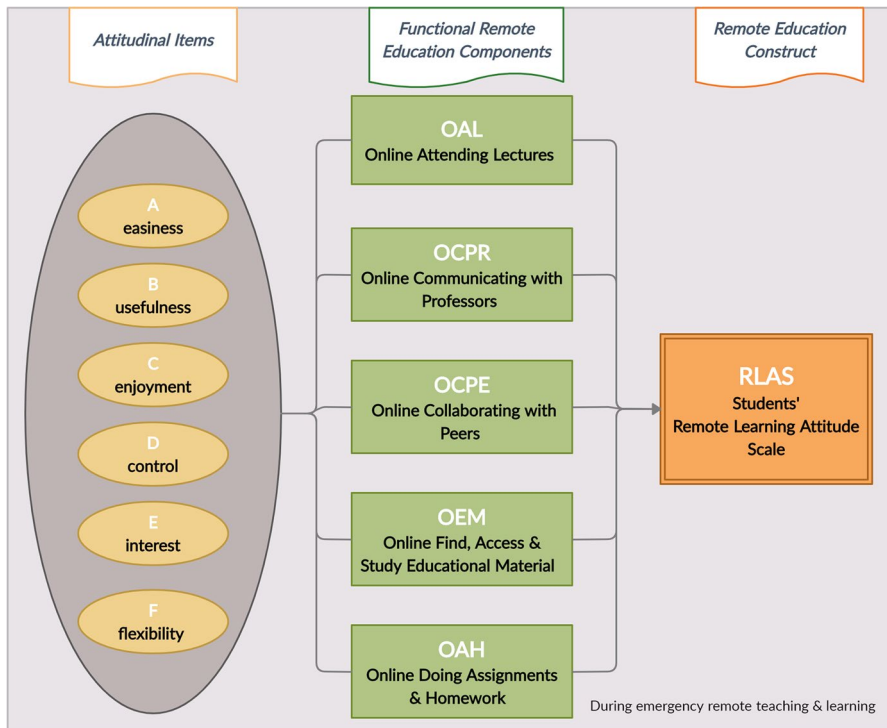
The RE components were designed accordingly to relevant works (e.g., Ni, 2013; Smith et al., 2011; Tanis, 2020) that emphasized on the importance of students’ interaction, communication and collaboration in online learning environments, compared with the traditional learning environments. The components design also considers the current RE functional modules in terms of synchronous attendance, educational material, and assignments.

The initial structure of the model and the item list was carefully reviewed by two experts in the field of Technology Enhanced Learning (TEL), to eliminate complex and difficulty perceived expressions, typos and recurrences. Finally, the instrument (DRAS) was composed by 5 RE functional dimensions:

- (1) Online Attending Lectures (OAL);
- (2) Online Communicating with Professors (OCPR);
- (3) Online Collaborating with Peers (OCPE);
- (4) Online Find, Access & Study Educational Material (OEM);
- (5) Online Doing Assignments & Homework (OAH).

Every dimension is evaluated by six attitudinal items regarding the students' perceived: (A) easiness, (B) usefulness, (C) enjoyment, (D) control, (E) interest, and (F) flexibility, as depicted in Fig. 1, compared with the corresponding dimension of the traditional learning (i.e., blended) mode (Fig. 2). The items were selected based on the literature review findings presented in Table 1.

Every attitudinal variable is measured by a single-item to simplify the structure of the multi-dimensional model. The selection of one item per attitudinal variable is based on the condition that it is acceptable with regard to reliability of the model (Sarstedt & Wilczynski, 2009) and is applied for particular non-complex constructs that can be clearly and homogeneously perceived (e.g., easiness, enjoyment, interest, etc.), as suggested by several works (Grapentine, 2001; Pollack & Alexandrov, 2013).



**Fig. 2** Measurement model of the students' Remote Learning Attitude Scale (RLAS)

The final scale contains 30 items presented in a 7-point Likert scale in a sequential mode ranging from “traditional learning” to “remote learning”, where students select the level they agree on the statement about the remote learning method compared to the usual one. In particular, students have to choose one of the seven points for every given statement where 1 = *Mostly in the usual (traditional) learning mode*, ..., 4 = *It makes no difference to me*, ..., 7 = *Mostly in the remote learning mode*. The instrument content is depicted in Table 9 (Appendix).

### 3.3 Data analysis

To evaluate the quality of the developed instrument, we conducted an exploratory factor analysis (EFA) using SPSS 17.0 software, and a confirmatory factor analyses (CFA) using the SmartPLS 3 software on the whole sample.

In the EFA, we applied the principal component analysis (PCA) with Promax with Kaiser Rotation, subjecting all 30 items. Because of the non-normal distribution of the data the partial least squares structural equation modeling (PLS-SEM) CFA was applied, instead of the covariance based (CB) approach (Asyraf & Afthanorhan, 2013; Rigdon, 2012).

Before conducting the EFA and CFA, we tested for the sample adequacy and the factorability of the data, performing the Kaiser–Meyer–Olkin (KMO) test (Kaiser, 1958) and the Bartlett’s test of sphericity (Bartlett, 1954).

To explore for potential differences among the examined student groups cross the five RLAS dimensions, the non-parametric statistical approaches of Mann–Whitney and Kruskal–Wallis were applied due to the resulted non normal distribution of the data.

## 4 Results and discussion

### 4.1 Exploratory factor analysis

Results of the Kaiser–Meyer–Olkin (KMO) test indicated the sample adequacy and the Bartlett’s (1954) test of sphericity confirmed the factorability of the data, as depicted in Table 3.

**Table 3** KMO and Bartlett’s test

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		.923
Bartlett’s Test of Sphericity	Approx. Chi-Square	4678,510
	df	435
	Sig	.000

**Table 4** Results of EFA on the 30 –items distant learning attitude scale (RLAS)

Factor/Item	Factor loading	Eigen value	Cumulative variance explained
1. OAL: Online Attending Lectures		1.53	73.64%
A1	0.800		
B1	0.824		
C1	0.768		
D1	0.709		
E1	0.828		
F1	0.674		
2. OCPR: Online Communicating with Professors		3.12	62.67%
A2	0.758		
B2	0.749		
C2	0.818		
D2	0.689		
E2	0.830		
F2	0.767		
3. OCPE: Online Collaborating with Peers		15.68	52.28%
A3	0.832		
B3	0.846		
C3	0.828		
D3	0.734		
E3	0.780		
F3	0.738		
4. OEM: Online Find, Access & Study Educational Material		1.10	77.31%
A4	0.753		
B4	0.834		
C4	0.782		
D4	0.729		
E4	0.771		
F4	0.749		
5. OAH: Online Doing Assignments & Homework		1.77	68.56%
A5	0.779		
B5	0.708		
C5	0.840		
D5	0.800		
E5	0.742		
F5	0.764		

The EFA results clearly indicated 5 components with Eigen values above 1, accounted for 77.31% of the common variance. Table 4 below, presents the item

wordings, factor loadings, and variance explained, for each factor. As depicted, the factor loadings are all above 0.5, meaning that all items were good measures of their respective factors (Hair et al., 2010).

## 4.2 Confirmatory factor analysis

A CFA was performed based on the PLS-SEM approach and using the Smart-PLS software. The model fit results indicated a valid value of Standardised Root Mean Residual ( $0.01 > SRMR = 0.059 < 0.08$ ), suggesting a good fit of the model (Henseler et al., 2014; Hu & Bentler, 1998). The results also confirmed the validity of the Normed Fit Index ( $NFI = 0.743$ ) and Chi-Square ( $= 1.446.811$ ) values according to the model fit acceptance criteria (Hair et al., 2010).

The internal validity of the model was evaluated in terms of the items' factor loading and Cronbach alpha scores. The results demonstrated highly valid scores of factor loadings according to the recommendations of accepting 0.5 as the minimum value (Hoque & Awang, 2016). The values of Cronbach alpha were all above the accepted threshold of 0.7 (Dijkstra & Henseler, 2015). Also, the performed bootstrapping procedure indicated that all values in the structural model are accepted and significant ( $t$ -values  $> 1.96$  and  $p$ -values  $< 0.01$ ).

The model's internal consistency and converge validity was evaluated in terms of the average variance extracted (AVE) and the composite reliability (CR). As depicted in Table 5 CR values are above the threshold of 0.7 (Gefen et al., 2000), and all AVE values are above 0.5 (Chin, 2010; Fornier & Larcker, 1981) confirming the reliability and consistency of the RLAS model.

The item-total correlations were also examined to determine the coherency of the items within the same component. Results showed that all item factor correlations are above the threshold of 0.3 (Pallant, 2011) ranging from 0.4 to 0.8. This result indicates that RLAS has significant items item-factor relationships and hence each item within the same factor serves that factor's [purpose as well as the general purpose of the RLAS. Moreover, the inter-correlations between the component did not exceed 0.7 (ranging from 0.47 to 0.7) suggesting that the factors are adequately distinct. For this, as presented in Table 6, the suggested RLAS model supports the discriminant validity between the constructs according to the criteria suggested by Fornell and Larcker (1981).

## 4.3 Differences among student-groups in the five dimensions of the RLAS

This study analyzed the relationships between student's individual factors of gender and age, their previous DE experience and the RLAS dimensions.

**Gender and age** The non-parametric analyses of Mann–Whitney revealed no significant gender and age differences cross the five RLAS components, similarly to previous research on online readiness (e.g., Hung et al., 2010) and attitude towards online learning (Chung et al., 2020). Also, our findings regarding age

**Table 5** Construct reliability and validity of the students' Distant Learning Attitude Scale (RLAS)

Components	Composite Reliability ( $\rho_c$ )		Average Variance Extracted ( $\rho_v$ )	
	Criteria <sup>a</sup>	Measurement	Criteria <sup>a</sup>	Measurement
OAL: Online Attending Lectures	> 0.60	0.950	> 0.5	0.760
OCPR: Online Communicating with Professors	> 0.60	0.952	> 0.5	0.768
OCPE: Online Collaborating with Peers	> 0.60	0.950	> 0.5	0.760
OEM: Online Find, Access & Study Educational Material	> 0.60	0.951	> 0.5	0.763
OAH: Online Doing Assignments & Homework	> 0.60	0.948	> 0.5	0.753

<sup>a</sup>Muthén and Muthén (2012), Bandalos (2018)



**Table 6** Discriminant validity

	OAL	OCPE	OCPR	OAH	OEM
OAL	0.872				
OCPE	0.648	0.876			
OCPR	0.743	0.699	0.872		
OAH	0.628	0.594	0.516	0.873	
OEM	0.531	0.539	0.501	0.702	0.868

and gender are in accordance with the recent work of Adanır et al. (2020) who examined students' attitude towards ICT-based courses in higher education.

**Field of study** A Kruskal–Wallis test indicated significant differences ( $p$ -value < 0.05) among the students participating in the three study programmes, in three RLAS dimensions: online collaboration with peers; online doing assignments and homework; and find, access and study educational material, as depicted in Table 7. Students participating in the postgraduate programme of Digital Marketing showed higher values of positive attitude towards the DE dimensions, while no significant differences existed between undergraduate and postgraduate students of the sample. It should also be considered that some more factors have might affect this outcome and further research need to be conducted on the programme study differentiations. The particular group of students in Digital Marketing was using a different DE platform (Zoom). Moreover, it is worthy to mention again that the programme also supports the option of DE for those students who wish to attend the courses remotely, even before the covid-19 crisis.

**Prior DE experience** The Mann–Whitney test (depicted in Table 8) revealed significant differences ( $p$ -value < 0.05) between students who had some previous DE experience and those who did not have any. The ones who had previous experience expressed higher levels of positive attitude towards the dimensions of online collaboration with peers and find, access and study educational material. This finding is in accordance with several previous works (Abdous, 2019; Hachey et al., 2015) showing that students' previous online learning experience can positively affect their attitude towards RE and their learning outcome.

#### 4.4 Practical implications

The suggested RLAS can serve as a quick and comprehensive tool for the evaluation of the students' attitude towards a set of main RE components like the remote

**Table 7** Kruskal–Wallis among student groups (Grouping Variable: study programme;  $N = 142$ )

	OAL	OCPE	OCPR	OAH	OEM
Chi-Square	5.622	2.329	10.596	9.738	7.829
df	2	2	2	2	2
Asymp. Sig	.060	.312	.005	.008	.020

**Table 8** Mann–Whitney test between student groups (Grouping Variable: Prior DE experience;  $N = 142$ )

	OAL	OCPE	OCPR	OAH	OEM
Mann–Whitney U	1718.500	1806.000	1575.000	1570.500	1666.000
Wilcoxon W	6471.500	6559.000	6328.000	6323.500	6419.000
Z	−1.660	−1.265	−2.312	−2.335	−1.907
Asymp. Sig. (2-tailed)	.097	.206	<b>.021</b>	<b>.020</b>	.057

synchronous attendance, communication with professor, collaboration with peers, educational material and assignments.

The RLAS can be applied by higher institutions during an ERE or other similar situation that educational modules need to be quickly or urgently transformed into fully digital and remotely accessibly. In particular, the application of RLAS can bring the following themes of practical implications:

1. **Prioritization of needs and time saving:** Usually, in an emergency situation like the covid-19 ERE, stakeholders do not have much time available to deeply organize their transition strategy and effectively design every single component. Since perfectionism cannot be achieved and failures tend to be usual (World Bank, 2020), policy makers need to make fast decisions on which parts of transition they should focus or invest their time on. The RLAS is a useful tool to quickly distinguish the RE components that need to be prioritized in terms of digital transition. By evaluating the students' attitude towards different RE components, in a comparative manner as the scale implies, higher institution educators, staff and learning managers will be aware of the components that students perceive more positively or the ones they perceive more negatively. This awareness will allow them to easier decide on the needs and priorities regarding the components that should be fully remote and the ones that are not so 'functional' yet and some alternatives (e.g., of blended or online learning) might be applied.
2. **Development of RE design strategy and continuity plan:** By applying the RLAS at an early stage, policy and pedagogy designers will be aware of the factors (items) that positively or negatively affect the students' attitude towards RE, allowing them to design better plans for educational continuity. Also, by measuring students' perceptual/attitudinal factors like their interest to attend remote lectures or their enjoyment of interaction and collaboration, specialists can research on the causes of potential students' disengagement and/or find pedagogical approaches and alternatives to leverage the students' engagement and active participation when necessary. For instance, implementing connectivistic teaching approaches can support students in enhancing their communication and collaboration skills while developing knowledge in a networked and more independent way. According to Bates (2019) connectivism is essential in today's digital society since contemporary online education renders connectivism a strong learning tool for distance learners. Similarly, constructive approaches can also be used in the

context of learning platforms (e.g., Moodle) to encourage students in collaborating with peers through team activities and forum discussions. Overall, RLAS can assist towards the selection of the applied pedagogical approach which should be based on the combination of the scale results, the students' characteristics, and the learning/teaching context.

3. **Flexibility and/or personalized RE services:** The results of this study revealed that some dimensions (online collaboration with peers and find, access and study educational material) need special attention because they are affected by external factors like the students' field of study and prior DE experience. This implies that teachers may need to help students of different experience levels and study programmes develop their online learning engagement and skills in collaboration and course-related activities (e.g., assignments).

Also, research has shown that there are a few more factors affecting the students' perceptions towards DE, including their learning style, personality traits, affective states, etc. (Abdous, 2019). Considering those differentiations educational institutions can (when this is technically feasible) apply personalized services offering to the students' different options and modes of remote learning. A simple example is that, asynchronous or textual communication could also be available since many students might express negative attitude towards peer collaboration or direct communication with the professor. As another example, video recording, which is supported by most of the videoconferencing platforms (Zoom, Google Meet, Microsoft Teams, etc.) used in education, could be applied so that students' that face difficulties (no matter the reason why) to attend synchronous lectures, will have the flexibility to watch the course in a different time.

#### 4.4.1 Possible limitations

The results of this study may have been affected by variance bias because the data was collected via a self-report-based questionnaire. In the future, this research could be complemented with a qualitative methodology, collecting data from classroom observations, or focus groups in order to measuring behavioral changes and reduces biases.

Moreover, due to the emergency situation there was not rich data available regarding previous scales and models for DE and its components. For this reason, this study needed to build a new research topology. However, this study provides the opportunity to validate and use new models adjusted to the ERE-covid-19 situation, proper to smooth the process of the educational transition towards ERE.

Third, the generalizability of the results could be limited since the dataset is specific to one country. Since there are cultural differences among countries, these should be reflected in future studies (Nistor et al., 2013).

Fourth, the representation of the students' population might not be efficient. Several students participating in the study attend particular study programs (e.g., Digital Marketing) and as the results showed, this has affected the results. Similarly, the fact that some students were already attending remote courses while others not may have caused some bias and affected the research results.

Finally, the structure of the proposed model could be further adjusted or enriched with more attributes that tend to affect students' attitude and performance in remote education. Such attributes could include achievement emotions (Pekrun, 2006; Pekrun et al., 2011), mood or personality traits (Abdous, 2019).

## 5 Conclusion

Higher education institutions take on extra responsibility when shifting to ERE and it is important to realize the difficulties that students face; hence they should be able to evaluate the students' preferences and attitude towards RE as opposed to their so far traditional teaching and learning experience.

To ease the load on educators and learners during an ERE transition, this study designs and validates a tool (RLAS) to evaluate students' attitude towards a set of functional RE components. The suggested 30-item scale is explored on a sample of 142 undergraduate and postgraduate students in Greek universities that needed to attend all their courses fully remotely due to the covid-19 crisis in the spring semester of 2020.

The EFA clearly revealed five dimensions of the students' distant learning attitude scale: i) Online Attending Lectures, ii) Online Communicating with Professors, iii) Online Collaborating with Peers, iv) Online Find, Access & Study Educational Material, and v) Online Doing Assignments & Homework. The PLS-SEM CFA validated the model by indicating good model fit measurements (SRMR < 0.08; NFI > 0.07), highly valid factor loadings (> 0.7), and internal validity and reliability (Cronbach's alpha > 0.7, Composite Reliability > 0.6, Average Variance extracted > 0.4).

This study also revealed the following outcomes in terms of students' individual factors:

- 'Gender' and 'age' did not make any difference across the five RLAS components;
- 'Field of study' showed significant differentiations in the dimensions of 'online collaboration with peers', 'online doing assignments and homework', and 'find, access and study educational material';
- 'Prior experience in DE and online learning' revealed significant differences in the students' attitude towards the dimension of 'online collaboration with peers', and 'find, access and study educational material'.

Despite its validity and practical contribution, the suggested scale can be further developed and adjusted to the covid-19 emergency situation by including psychological and social items, to assess for instance the students' anxiety or perceived isolation towards the RE dimensions. This will be highly contributing mainly because of the profound impact that the covid-19 emergency psychological issues (e.g., trauma, anxiety, pressure) has brought to learners all over the world.

## Appendix

**Table 9** Scale of students' attitude towards remote education

Range of 7 points	[Usual – Online]
Description	In each question, choose from 1 to 7 depending on how much you prefer the Usual over the Remote/ Online way of teaching & learning 1 = Mostly in the Usual, ..., 4 = I'm the same, ..., 7 = Mostly in the Remote/Online
Instrument	
Item	Content
OAL: Online Attending Lectures	
A1	It is easy to Attend lectures
B1	It is useful to Attend lectures
C1	I enjoy to Attend lectures
D1	I have control when to Attend lectures
E1	I am interested (engaged, motivated) when I Attend lectures
F1	I have flexibility and many opportunities to Attend lectures
OCPR: Online Communicating with Professors	
A2	It is easy to Communicate with the professor
B2	It is useful to Communicate with the professor
C2	I enjoy to Communicate with the professor
D2	I have control when to Communicate with the professor
E2	I am interested (engaged, motivated) when I Communicate with the professor
F2	I have flexibility and many opportunities to Communicate with the professor
OCPE: Online Collaborating with Peers	
A3	It is easy to Collaborate with my peers (co-students)
B3	It is useful to Collaborate with my peers (co-students)
C3	I enjoy to Collaborate with my peers (co-students)
D3	I have control when to Collaborate with my peers (co-students)
E3	I am interested (engaged, motivated) when I Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.)
F3	I have flexibility and many opportunities to Collaborate with my peers (co-students)
OEM: Online Find, Access & Study Educational Material	
A4	It is easy to Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.):
B4	It is useful to Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.)

**Table 9** (continued)

C4	I enjoy to Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.): Usual [Online]
D4	I have control when to Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.)
E4	I am interested (engaged, motivated) when I Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.)
F4	I have flexibility and many opportunities to Find, Access and Study educational material (class notes, presentation slides, bibliography, etc.)
OAH: Online Doing Assignments & Homework	
A5	It is easy to Do the assignments, homework, etc
B5	It is useful to Do the assignments, homework, etc
C5	I enjoy to Do the assignments, homework, etc
D5	I have control when to Do the assignments, homework, etc
E5	I am interested (engaged, motivated) when I Do the assignments, homework, etc
F5	I have flexibility and many opportunities to Do the assignments, homework, etc

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