



# Data-driven decision-making in emergency remote teaching

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## Abstract

Decision-making is key for teaching, with informed decisions promoting students and teachers most effectively. In this study, we explored data-driven decision-making processes of K-12 teachers (N=302) at times of emergency remote teaching, as experienced during the COVID-19 pandemic outbreak in Israel. Using both quantitative and qualitative methodologies, and a within-subject design, we studied how teachers' data use had changed during COVID-19 days, and which data they would like to receive for improving their decision-making. We based our analysis of the data on the Universal Design of Learning (UDL) model that characterizes the diverse ways of adapting teaching and learning to different learners as a means of understanding teachers' use of data. Overall, we found a decline in data use, regardless of age or teaching experience. Interestingly, we found an increase in data use for optimizing students' access to technology and for enabling them to manage their own learning, two aspects that are strongly connected to remote learning in times of emergency. Notably, teachers wished to receive a host of data about their students' academic progress, social-emotional state, and familial situations.

**Keywords** Teachers · Data-driven decision-making · Emergency remote teaching · Universal design for learning · COVID-19

## 1 Introduction

Teachers' data-driven decision making (DDDM)—that is, teachers' collection, analysis, and using data to guide and support educational decisions—is key to teaching, and practicing it has shown that it improves teaching and to promotes student learning (Carlson et al., 2011; Mandinach & Jackson, 2012; Pulham & Graham, 2018; Sawyer,

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2006; van der Scheer & Visscher, 2018). DDDM can take into consideration a plethora of aspects of the students' characteristics and of their learning, e.g., demographics and familial information, academic level, meta-cognitive skills, or socio-emotional behavior; each of these could be described with either quantitative or qualitative data. Of course, DDDM is personal in nature, and the same data could lead different teachers to different decisions, based on their educational agenda and contextual considerations (Škėrienė & Augustinienė, 2018).

Teaching during COVID-19 pandemic outbreak has faced teachers with at least two major challenges that may have affected their DDDM. First, the very setting of teaching has changed, as schools shifted from face-to-face to remote teaching; this impacted the ways by which teachers could collect data about their students, as well as teachers' need to re-evaluate pedagogical decisions to support their students (Usher et al., 2021). Second, the emergency situation has emphasized the affective aspects of learning, which may have impacted teachers' very decisions, as well as the types of data required to support these decisions (Roman et al., 2021; Yang et al., 2021). That is, the very setting of emergency remote teaching may have influenced teachers' DDDM dramatically.

Currently, there is still a lack of research on decision-making among teachers in distance learning and, in particular, in times of emergency. We address this gap by studying teachers' data driven decision-making during the shift to remote learning due to the outbreak of COVID-19. This study aimed to understand teachers' use of data before and during COVID-19 days, and to reveal what types of data teachers wish to get in order to improve their teaching and their students' learning. We were guided by the following research questions:

1. How has teachers' use of data to promote learners changed during COVID-19 days?
2. What are the associations between teachers' data use before and during COVID-19 days and their personal characteristics and modes of teaching?
3. What types of data do teachers wish to get in order to improve teaching and student learning?

## 2 Literature review

### 2.1 Teachers' decision-making

Teachers' work encompasses the decisions they make on a regular basis regarding various issues throughout the teaching process. Such decisions can be related to didactical practices, curricular considerations, assessment methods, resource allocation, implementation of digital tools, appraisal or disciplinary responses, etc.; they may be taken in-the-moment, during lessons, or in out of the classroom setting. Shavelson (1973) argued that any teaching act is a result of a decision, either conscious or unconscious, and Hunter (1979) claimed that teaching

is decision making. Still, teachers often take decisions intuitively and not in a systematic manner (Van Geel et al., 2016; Vanlommel et al., 2017).

Informed decisions, which are based on relevant data, are the ones that will promote students most effectively (Carlson et al., 2011; Poortman & Schildkamp, 2016; van der Scheer & Visscher, 2018). Therefore, data-driven decision-making (DDDM)—that is, collecting and analyzing data to guide and support educational decisions—is increasingly seen as a core skill for teachers (Schildkamp et al., 2014; Vanlommel et al., 2017).

Teachers' DDDM includes a few skill-sets, including the ability to access and gather reliable, high-quality student data, the ability to use technology-based systems that handle such data, and the ability to effectively use these data and systems to amplify student learning and well-being (Dunn et al., 2013). Relevant data for that purpose may include assessment outcomes, students' background information, and various cues derived during classroom observations.

## 2.2 Emergency remote teaching and DDDM

Effective online learning requires thorough design and planning (Hodges et al., 2020). However, in times of emergency—as was experienced during the recent COVID-19 pandemic outbreak—a shift to online learning is often done hastily, hence without proper preparation. The impact of the COVID-19 pandemic, as a specific case of emergency remote teaching (ERT) on the education systems worldwide, has been overwhelming. It has revealed a significant liability in preparation and training for ERT, aimed to ensure students' continuous learning despite the shift from in-person to a massive online remote teaching and learning (Trust & Whalen, 2020; Xie et al., 2021).

Under ERT conditions, issues such as accessibility, equity and special needs, digital divides, privacy and security are magnified, in aspects that range from infrastructure and devices, through learning environments in the homes, to learning and assessment methods (Czerniewicz et al., 2020; Peterson et al., 2020; Thompson & Copeland, 2020). This has profoundly challenged educators' pedagogical reasoning and decision-making, which highlights the vitality of using data for making optimal decisions in distance learning in times of emergencies (Aguilera & Nightengale-Lee, 2020). ERT requires ongoing improvements in curriculum design and practice, which requires in turn decision-making about teaching and learning standards; however, teachers were caught unprepared (Hodges et al., 2020; Zhang, 2020).

## 2.3 Theoretical framework

One of the primary goals of teachers' decision-making process is to improve teaching and learning for all students. The Universal Design for Learning (UDL), being a conceptual framework that addresses diverse student characteristics, presents a comprehensive viewpoint on teachers' decision making. The UDL framework presents three principles: engagement, representation, and action and expression. Each is defined on three different levels, which relate to different

learning stages: access, build, and internalize, defining a matrix of size 3\*3. Each cell refers to practical ways of accessing learning materials by one of the principles and one of the stages of learning (CAST, 2018; Moore, 2007).

UDL can be applied in a wide range of contexts, from one-on-one tutoring to a single classroom and to a whole school environment, and can assist in choosing learning resources or digital tools, or while designing instruction at the lesson-level or at the curriculum-level (Rao et al., 2020). Consequently, UDL may be seen as a means to facilitate teachers' decision making, and a framework of assessing this process (Harris & Yearata, 2019; Novak & Rodriguez, 2018); therefore, UDL is the framework for our study.

### 3 Methodology

This study is an empirical research that combines qualitative and quantitative data regarding teachers' use of learners' data in pre-and during-COVID-19 days, as drawn from an online self-report questionnaire. This study combines qualitative and quantitative data regarding teachers' use of learners' data in pre- and during-COVID-19 days, as drawn from an online self-report questionnaire.

#### 3.1 Research variables

Background variables included gender, age, teaching experience, and school-level [elementary-, middle-, or high-school].

The two independent variables were:

- Types of data generally used for professional decision-making [academic, behavioral, socio-emotional, familial];
- Ways of teaching during COVID-19 pandemic [remotely synchronously, remotely asynchronously, in-class with the whole classroom, in-class with sub-groups of the classroom]

Each value for each variable was ranked on a 3-point Likert scale (1 - "To a Low Extent"; 2 - "To a Medium Extent"; 3 - "To a High Extent").

The dependent variables were a set of nine pairs of variables, each of which referred to one component of the Universal Design for Learning (UDL) framework, and within each such a couple – measures referred to teaching in pre- and during COVID-19 pandemic days. Hence, an overall of 18 variables (3\*3\*2) measuring the actual use of data to promote learners in relation to each of UDL's topics [engagement, representation, action and expression], to each of UDL's levels [access, build, internalize], in both teaching times [before, during COVID-19].

### 3.2 Research field

This study was carried out in Israel, where the education system is mostly public, centralized and is typically divided into three school levels: elementary- (first-sixth), middle -(seventh-ninth), and high- (tenth-twelfth) schools. As a result of the COVID-19 pandemic outbreak, in mid-March 2020, all Israeli schools countrywide closed due to national lockdown, and teaching and learning were held remotely; schools had operated remotely, at least in part, until January 2021.

### 3.3 Research population

The questionnaire was distributed via the authors’ professional and personal networks, in order to reach to a variety of participants. The inclusion criterion was teaching during the 2020/21 school year and having experience in teaching before the COVID-19 outbreak; this criterion was set so participants could compare their COVID-related teaching experience with their prior experience.

### 3.4 Research tool and procedure

Our main research tool was an online questionnaire sent via the authors’ personal and professional networks. Data collection took place during October 2020, when teaching was still remote. We developed a questionnaire for measuring the dependent variables, with 9 corresponding statements. We cycled a draft among 10 teachers for testing the items’ validity and clarity. Each item opened with "I actually use learners’ data to...", and continued as follows (Fig. 1):

- (1) "... create and allow freedom of choice in their learning"

Principles learning stages	Provide multiple means of <b>Engagement</b> 	Provide multiple means of <b>Representation</b> 	Provide multiple means of <b>Action &amp; Expression</b> 
<b>I actually use learners' data to..</b>			
<b>Access</b>	“create and allow freedom of choice in their learning”	“enable their access to textual, visual, and audial content”	“enable them optimal access to technology”
<b>Build</b>	“help them pursue their learning (e.g., by setting goals, promoting collaboration, and giving feedback)”	“enable their usage of various information representations (e.g., verbal, mathematical, visual)”	“enable them to express themselves in various ways and by various means”
<b>Internalize</b>	“promote their self-regulation of learning and their goals achievement”	“promote their meaningful knowledge construction”	“enable them to manage their own learning”

Fig. 1 Questionnaire questions represented in the UDL model

- (2) "... help them pursue their learning (e.g., by setting goals, promoting collaboration, and giving feedback)"
- (3) "... promote their self-regulation of learning and their goals achievement "
- (4) "... enable their access to textual, visual, and audial content"
- (5) "... enable their usage of various information representations (e.g., verbal, mathematical, visual)"
- (6) "... promote their meaningful knowledge construction"
- (7) "... enable them optimal access to technology"
- (8) "... enable them to express themselves in various ways and by various means"
- (9) "... enable them to manage their own learning"

Each item was ranked twice, referring to pre- and during-COVID-19 pandemic teaching, on a 4-point Likert scale, from "I do not agree at all" to "I fully agree".

Also, we had one open-response item, "If you could get any data about your learners, in order to promote their learning and your teaching, what types of data would you wish for?" (Notice [appendix](#)).

We coded each response with the following codes: academic, behavioral, socioemotional, and familial. Coding was done independently by two of the authors, with 83% agreement, after which they discussed their coding, resolved gaps, and reached full agreement. Following a discussion between all three authors, a fifth category was extracted from "socioemotional", namely "motivational", due to its prominence.

### 3.5 Data analysis

The statistical analyzes were performed using JASP software. Because the data related to the use of the data (based on the UDL model) were collected through an ordered scale, we used asymmetric tests, particularly the Spearman and Wilcoxon.

The coding process included the following sequential steps. First, two of the researchers separately analysed the responses in a top-down manner, in accordance to identification of categories related to data utilization by teachers about the learners, as reported in the literature. The coded categories included: academic, behavioural, socioemotional, and familial—all related to students' data. An agreement of 83% between the coders was reached at this stage. Then, a joint discussion was conducted between the two coders, in which all gaps were resolved, thereby reaching full agreement on the classification of responses. Finally, the three authors discussed the coding scheme, and decided to extract an additional category, which so far was considered a sub-category of the "socioemotional" category, that is, "motivational", due to its prominence in the responses.

### 3.6 Ethical considerations

The study received approval from the University Ethics Committee and the Ministry of Education. We did not collect any identifying information via the questionnaire. Respondents were kindly requested to give their explicit informed

consent to take part in this study via the first item in the questionnaire, before responding to any of its further items related to the theme of the study.

## 4 Findings

### 4.1 Research participants

Of our participating 302 teachers, 78% (237) were females, and 21% (63) were males, a ratio similar to the national teacher population (81%, as of 2021/22 school year) (Central Bureau of Statistics, 2022). Their average age was 45.5 years old ( $SD=10.0$ ,  $N=302$ ); the average teaching experience was 16.9 years ( $SD=10.6$ ). 28% (86) were elementary school teachers, 19% (56) -middle school teachers, 34% (104)—high school, and 20% (60) were both middle- and high school teachers; hence, the sum is over 100%.

### 4.2 Overall data use before and during COVID-19

Participants reported medium degrees of using learners' data to promote learners in pre-COVID-19 teaching, with averages ranging from 2.9 for the Action-Access dimension, to 3.4 for the Engagement-Build dimension. Results are summarized in Table 1.

We used Wilcoxon's Rank Test to compare between pre- and during- COVID-19 values of teachers' use of learners' data. As findings suggest, in 5 of 9 UDL dimensions, there was a significant decrease in the use of learners' data, for all stages of Engagement. Also, significant decreases were found for Representation-Internalize dimension, and Action-Build dimension; these differences depict low-medium effect size.

An increase in data use was found for two stages of Action, namely, Access, and Internalize; the effect size of the difference in the Access stage was medium–high ( $RBC=0.68$ ), while the effect size for Internalize was low ( $RBC=0.25$ ). Results are summarized in Table 2.

**Table 1** Mean (SD) of teachers' use of learners' data in pre-COVID-19 days ( $N=302$ )

Principle Stage	Engagement	Representation	Action
Access	3.2 (0.8)	3.2 (0.8)	2.9 (0.9)
Build	3.4 (0.7)	3.2 (0.8)	3.3 (0.7)
Internalize	3.3 (0.7)	3.3 (0.6)	3.0 (0.8)

**Table 2** Mean (SD), Wilcoxon's Rank Test value, and effect size (Rank-Biserial Correlation [RBC]) of the difference in teachers' use of learners' data during COVID-19 days [during minus pre] (N=310)

Principle Stage	Engagement	Representation	Action
Access	-0.09 (0.74) W = 3176* RBC = 0.21	0.03 (0.63) W = 1876 p = 0.98	0.36 (0.80) W = 1399*** RBC = 0.68
Build	-0.15 (0.70) W = 2573*** RBC = 0.41	-0.07 (0.71) W = 2223 p = 0.10	-0.13 (0.74) W = 3004** RBC = 0.35
Internalize	-0.17 (0.77) 3288*** RBC = 0.41	-0.16 (0.70) W = 2758*** RBC = 0.44	0.13 (0.81) W = 2682* RBC = 0.25

### 4.3 Associations between data use before and during COVID-19 and personal characteristics, modes of teaching

#### 4.3.1 Gender

Overall, female teachers' use of learners' data was significantly higher than that of males across a few UDL dimensions. In pre-COVID-19 days, this was evident in the following UDL dimensions: a) Engagement-Access; b) Engagement-Build; c) Representation-Build; and d) Action-Internalize. During COVID-19 days, this was evident in the following UDL dimensions: a) Engagement-Access; b) Representation-Access; and c) Representation-Build. Results are summarized in Table 3.

#### 4.3.2 Age, teaching experience

We found almost no significant associations between teachers' data use in pre-COVID-19 days and their age or teaching experience, apart from a weak negative correlation with the Representation-Access dimension. No statistically significant associations were found between age or teaching experience and teachers' data use during COVID-19 days.

#### 4.3.3 Grade-level

Overall, we found that elementary school teachers' use of student data in pre-COVID-19 days was higher than high-school teachers. Running One-Way ANOVAs, and examining post-hoc Scheffe tests, these differences were evident in the following dimensions: a) Representation-Access,  $F(2,236) = 7.3$ , at  $p < 0.01$ . Mean difference between elementary- and high-school teachers was 0.42 (SD = 0.11), at  $p < 0.01$ ; b) Representation-Build,  $F(2,236) = 4.3$ , at  $p < 0.05$ . Mean difference between elementary- and high-school teachers was 0.34 (SD = 0.12), at  $p < 0.05$ ; c) Action-Build,  $F(2,236) = 4.0$ , at  $p < 0.05$ . Mean difference between elementary- and high-school teachers was 0.28 (SD = 0.10), at  $p < 0.05$ ; and d) Action-Internalize,  $F(2,236) = 2.6$ , at  $p < 0.05$ . Mean difference between elementary- and high-school teachers was 0.32

**Table 3** Mean (SD) of UDL components between female (N = 245) and male (N = 63) participants, before and during COVID-19 days

Principle Stage	Engagement	Representation	Action
<b>Before COVID-19</b>			
Access	Female	Female	Female
	Male	Male	Male
Build	Female	Female	Female
	Male	Male	Male
Internalize	Female	Female	Female
	Male	Male	Male
<b>During COVID-19</b>			
Access	Female	Female	Female
	Male	Male	Male
Build	Female	Female	Female
	Male	Male	Male
Internalize	Female	Female	Female
	Male	Male	Male

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

(SD=0.11), at  $p < 0.05$ . Note that for these analyses we only considered teachers who taught a single school-level (elementary-, middle-, or high-school), hence the lower N. No differences were found regarding teaching during COVID-19.

#### 4.3.4 Modes of teaching during COVID-19 days

Only a few significant associations were found between the mode of teaching and UDL dimensions referring to teacher's use of learners' data during COVID-19 days. Specifically, the more frequent asynchronous learning was practiced, the higher was teachers' use of learners' data regarding Representation-Access, Representation-Internalize ( $\rho = 0.19$ , at  $p < 0.001$  for both) and Action-Internalize ( $\rho = 0.13$ , at  $p < 0.05$ ) dimensions. Also, the more frequent learning in capsules in the physical classroom was practiced, the higher was teachers' use of learners' data regarding the Action-Access dimension ( $\rho = 0.12$ , at  $p < 0.01$ ).

#### 4.4 Data teachers wished to get

These findings are based on analysis of teachers' responses to the open-ended question about what other information they would like to receive. Although asked about it in a general way, some had specific references to teaching and learning during COVID-19 days.

Of the responses, 41% (73 of 177) were coded as socio-emotional, 35% (63 of 177) as academic, 32% (57 of 177) as home-related, and 25% (45 of 177) as motivational. No response was coded as behavioral. Note that a single response may have been coded into more than one category.

##### 4.4.1 Social-emotional data

This was the most prominent category in teachers' responses regarding data they wished to get. Most of the statements referred to students' emotional status (66 of 73, 90%), and about a third referred to students' social state (23 of 73, 31%).

**Emotional data** Teachers wanted to receive information about students' emotional state, especially in light of the COVID-19 situation, because "the personal and emotional state influence the academic availability, whether physical or mental availability" (T272). Therefore, it was important for them "to understand how much [the students are] available for learning" (T150). Their students' emotional state has become "the most important thing" (T54) in times of pandemic and quarantines.

**Social data** Teachers also wished to receive information about students' social status, in order to "know how to team them up for group work" (T40), as well as to know "which of their friends can help, and who interferes in achieving the goals" (T42). Some teachers addressed the two aspects together, i.e., emotional and social data, being a prerequisite for learning and more important than content, for example: "Emotional, mental, social, and behavioral information is more critical than learning

skills because it is easier to teach thinking and learning skills than to create or build emotional and social resilience" (T208). Over 20% of the statements under this category generally referred to the need of teachers for "emotional-social data", without further elaborations.

#### 4.4.2 Academic data

Under this category, we incorporated statements referring to a few aspects of learning and teaching including comprehension difficulties (17 of 63, 26%), learning skills (11 of 63, 17%), learning disabilities (10 of 63, 16%), feedback about teaching (9 of 63, 14%), and students' digital literacy (7 of 63, 11%).

**Comprehension difficulties** A third of the teachers' statements referred to their wish to get data related to students' understanding of the taught material in order to know "what they did not understand and why" (T151). One of the purposes for this may be to "organize learning groups according to [students'] abilities" (T258), emphasizing the need for support learners based on their own needs. Teachers felt that in COVID-19 days, even the necessary academic data about students' difficulties were lacking, since distance learning impaired the ability to assess students' learning: "In COVID-19 days, when it is impossible to meet face to face with the students, there is a lack of data about the quality of learning for each student, particularly the weakest among them" (T76).

**Learning skills** About one-fifth of the statements referred to information about students' learning skills in specific subject matters, e.g., "how much they master learning skills" (T304). Also, they were interested in students' ability to manage their own learning, especially in remote learning conditions; hence, they wished to know "are they able to study independently" (T70), or are they "able to sit concentrated for 45–90 min according to what the education system requires" (T289). This portrays teachers' acknowledgement that learning conditions are fundamentally different in ERT settings.

**Learning disabilities** A few statements referred to teachers' wish for information about students' learning disabilities, so they could "get as much as possible to the root of the problem and give a more effective answer" (T313). They also wanted didactic and psychological-didactic diagnoses, e.g., "full information from psycho[logical] didactic diagnoses and concrete recommendations for a variety of tools and methods that can help" (T272); "what learning style is right for him and if he has a [psycho[logical] didactic] diagnosis?" (T40).

**Feedback about teaching** A few statements referred to teachers' wish to get feedback about their teaching, for example, "in what form do they [students] like to learn" (T300); "how easy it is for them to learn... What tools are better for them" (T233); "what explanations helped them in learning, which teaching methods create

interest and learning" (T56); and to overall get "feedback on my lesson, did they enjoy it? Was the lesson significant?" (T48).

**Digital literacy** Lastly, only a few statements referred to students' digital literacy, especially in the COVID-19 days, which were heavily based on online learning and digital devices. Regarding their students, teachers wished to know "what is their technological literacy?" (T34); "what are their technological capabilities?" (T270). Despite of the importance of digital skills in remote learning, this issue was mentioned in only a few statements.

#### 4.4.3 Home-related data

Under this category, there were statements referring parental cooperation and support for students' learning (16 of 57, 28%), financial situation (14 of, 57, 25%), and technological infrastructure (14 of, 57, 25%).

**Parental cooperation and support** Teachers were troubled by "the [students'] relationship with their parents and the parents' cooperation" (T77). Specifically, they wished to know "whether [the students] were receiving support or help from the family?" (T289), and if "there are parental presence and support" (T255), or "parental encouragement" (T211).

**Financial situation** About a quarter of the statements were concerned about students' families' financial situation. Many responses generally mentioned "socio-economic status", without elaboration. When specified, teachers explicitly referred to their wish for information about the existence of "best conditions for learning" (T24), or "technological means" (T182). In some cases, in light of the national unemployment crisis during the pandemic, teachers specifically mentioned their wish for information about whether the students "are forced to work to support the family" (T282). One of the teachers put it clearly: "financial situation is the key – if it's ok, then the social and the achievement situations improve" (T18).

**Technological possibilities at home** Since ERT has been mostly computer-mediated, Internet connection and digital devices at home were vital to students' learning. Hence, teachers were interest in information about students' "accessibility to technology (T301) and "infrastructure for distance learning" (T189), as well as about their and "accessibility of means of communication: cell phone or computer" (T54), "Internet accessibility" (T97) "the number of computers in the home given the number of siblings" (T147) in order to make sure they have "accessibility to computer" (T203) and "optimal conditions for distance learning" (T24).

#### 4.4.4 Motivational data

Statements under this category were related to what motivates students (28 of 45, 62%), their interests (18 of 45, 40%), and their strengths and weaknesses (6 of 45, 13%).

**What motivates students** Some of these statements demonstrated teachers' wish for understanding their students' motives, in order to have a grasp of "how to bring them closer to learning?" (T233). It seems that—as teachers perceived it—learning from home poses additional motivational aspects for students, hence they wanted to have a deep understanding of these aspects, as in, "what motivates them to get up in the morning? what can get them out of bed on a rainy day?" (T14); "What are the motivations in out-of-school and in-home settings? What are the motivations within the school in lessons and activities other than my own?" (T176).

**Students' interests** Teachers wished to have information about students' general fields of interest, like "personal interests, dreams, memories and experiences from their daily lives" (T161), "how they spend most of their day?" (T157), about "their hobbies, participation in annual trips, contribution to the community and to school" (T39), and "things that he loves as a starting point for a subject to be learned" (T284). Such information may help teachers to increase students' engagement.

**Strengths and weaknesses** Teachers tend to use their intuition regarding students' strengths and weaknesses while teaching in the physical classroom, as they have access to various visible cues; however, remote teaching is challenging for attaining such impressions. About 13% of all statements regarding motivation were related to strengths and weaknesses, e.g., "what are their objective difficulties, what are the areas of strength" (T262), in order to know "what they are best at?" (T38). This information was requested by teachers in order for them to connect to their students, while teaching in a given subject matter, "using the things they love " (T284) or to "give them tasks that will interest them and increase their motivation to learn" (T168) on routine and ERT.

## 5 Discussion

Our study explored teachers' DDDM in times of emergency remote teaching. Overall, teachers reported on medium–high use of data for improving student advancement and well-being. Teachers used data that was available to them such as academic, behavioral, emotional, and family information, and yet reported that they wished to receive more information about their students. Small differences were found between the use of data by female teachers compared to male teachers and no associations were found between data use and teachers' age or teaching experience. This may be explained by the direct relationships between

perceptions and beliefs about data use and the use of data de-facto, which are age- and experience-independent (Hoogland et al., 2016; Schildkamp & Ehren, 2013).

Notably, we found a decline in data usage during ERT, possibly due to the hectic pedagogical shift and differences in data availability and access, which led teachers to focus only on the day-to-day management of their work. However, in two dimensions of the UDL model, we found an increase in data use during COVID-19 days: teachers used more data to allow students' optimal access to technology, and to enable them to manage their own learning. This indicates that teachers' primary focus during ERT was to ensure students' technological access to infrastructure and their engagement in learning and moreover in managing their learning. This seemingly-narrow viewpoint highlights teachers' hardship during ERT, mostly as a result of insufficient preparation and training (Arcueno et al., 2021); indeed, many teachers turned to their peers for assistance or navigated the Internet for solutions (Trust & Whalen, 2020).

Teachers indicated they used available data that influenced their decision-making, and wished to receive a wide range of additional academic, social-emotional, and familial data as a means of improving their decision-making. Academic data—specifically regarding students' performance—was lacking during COVID-19 days, primarily due to the decrease in academic assignments and the inability of teachers to watch students perform tasks in person. This is associated with reports according to which assessment was a significant challenge for teachers in ERT, since teachers are accustomed to assessing students in a face-to-face classroom setting (Arcueno et al., 2021; Aslan et al., 2021).

Information regarding students' motivation was of particular interest to teachers during COVID-19 days, being an essential prerequisite for learning (Kurilovas, 2020; Öçal et al., 2021). Engaging students in remote learning was challenging, therefore teachers were interested in raising their students' motivation, specifically in these times of crisis. Family-related information regarding learning conditions at home—such as access to technology, or parents' assistance in learning—was especially mentioned as missing, though crucial for decision-making in ERT. The students' familial situation affects their academic abilities in typical days and moreover in such times of crisis, when families were locked in their houses and could not maintain a routine (Öçal et al., 2021). Hence, making informed educational decisions that incorporate familial perspectives may assist, in times of crisis, in addressing various concerns (Aguilera & Nightengale-Lee, 2020).

Overall, data indicated that teachers needed to see students in a holistic manner as prerequisite for improving their decision-making in educational contexts. Besides assisting students more efficiently and effectively, keeping a DDDM routine may contribute to teachers' professional growth (Michaeli et al., 2020; Pulham & Graham, 2018), hence may contribute to education at large.

## 6 Conclusions and Recommendations

In this study (N=302), we explored teachers' use of data to promote students in times of emergency, as experienced during COVID-19 pandemic outbreak. Overall, teachers' data use for promoting students decreased during COVID-19 days, with

the exceptions being promoting access to technology and promoting student management of their own learning (RQ1); these two aspects are strongly related with teaching and learning in times of emergency. We found that data use was higher among female teachers (compared with male teachers) and in elementary school (compared with secondary school), with no meaningful associations with age, teaching experience, or modes of teaching during COVID-19 days (RQ2). Finally, we found that teachers wish to get various types of data about their students, including socio-emotional, academic, home-related, and motivational (RQ3). Following these findings, we suggest the following recommendations that would help teachers to address diverse student characteristics and needs, and in turn, to promote a better DDDM in the spirit of UDL.

### **6.1 Promote a sustainable culture of data-driven decision-making in schools**

As our findings suggest a decline in data use in times of emergency, where DDDM is crucially important, we recommend to constantly promote a culture of DDDM in schools and in education systems at large. Once it is an integral component of the teaching profession, it will be utilized in routine and in ERT. Adopting DDDM processes as a routine requires training and should be included in teacher training curricula for both preservice and in-service teachers.

### **6.2 Make diverse and rich data of different types accessible to teachers**

As teachers wish to use various types of data, comprehensive and diverse information of different types should be made available to them, in order to better their DDDM. These go beyond academic data and should include socio-emotional, family-related, and motivational data. This data is essential in routine times, and especially during times of emergency. For this data to be usable, it should be made accessible to teachers in a user-friendly way. Moreover, teachers should be involved in processes of developing interfaces for data collection and presentation, for increasing the relevance and effectiveness of such interfaces.

### **6.3 Help teachers promote students as whole persons**

Following our finding regarding the special interest of teachers in non-academic data, it is recommended to find routes through which teachers will connect to their students and promote the whole persons that they are, in a holistic manner. This could be achieved by various means, for example, initiating open, honest discussions about what drives students, or adapting content and pedagogies as to make learning more relevant, authentic, and engaging.

## 7 Study limitations

As with any study, the present study is not without its limitations. Its main limitation lies in the fact that it was conducted in a single country, characterized by a specific culture of education and technology, and by specific ways in which COVID-19 had affected the population; moreover, we cannot assure that our research population is representative of the whole teacher population in the country. Furthermore, relying on an online questionnaire may have been more inviting to teachers with technical abilities to respond, hence this may somewhat bias to the findings. Therefore, our findings should be validated by similar studies in other contexts. Still, our detailed statistical analyses and findings may be useful to the general population, especially due to contemporary issues raised as a result of COVID-19 and its implications.

## Appendix

Dear teachers,

The questionnaire is distributed as part of a broad study on decision-making in teaching and intended for teachers who taught before and during the outbreak of the COVID -19 pandemic.

The questionnaire is anonymous and takes about 10 minutes to complete. The study is led by [ANON]; questions regarding the research or the items may be directed to [ANON].

Completing this questionnaire includes approval to participate in the study. Please mark below to continue.

- I agree to participate in the study

### Gender

- Male
- Female
- Prefer not to specify
- Other

**Age:** \_\_\_\_\_

**Teaching experience (years):** \_\_\_\_\_

**The location of your school:** \_\_\_\_\_

**Your teaching layers (multiple choice):**

- Elementary school
- Middle school

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## Declarations

**Conflict of interest** We have no conflicts or interests to disclose.

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