UNIVERSITY OF TWENTE
Faculty of Behavioral, Management and Social sciences (BMS)
Department of Instructional Technology

The effects of presentation order of examples in video instruction

Hajnalka Dancsi

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Examination committee:

Dr. Hans van der Meij
Dr. Alieke van Dijk

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Abstract

The study investigated the effect of a varying sequence of correct and incorrect video-based examples on engagement, self-efficacy, emotional reactions to error, error analysis and task performance. In past researches, example design variants such as the type error explanation provided for the erroneous example or the variation in the presentation of examples may have contributed to mixed results of knowledge gains. To understand if the presentation order of examples affects learning, a quantitative research with a pre-test-post-test design was created with two experimental groups (correct-incorrect and incorrect-correct examples), and a control group (correct examples only). Results found in the correct-incorrect group a link between the decrease of negative emotions and the increase of transfer test score, and a link between participants increase of error analytical skill and their higher retention test scores. In all three conditions, participants scored high on video engagement and held increased self-efficacy beliefs after training. Mixed example conditions did not trigger negative emotional reactions. Both mixed examples conditions were more effective in developing error management skills, but general task performance was equally effective in all three groups. The outcome suggests that there is a potential in using a mix of correct and incorrect procedures to effectively teach software skills, especially when error management information is given.

Keywords: *example-based learning, video, engagement, self-efficacy, emotions, error-management*

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1. Introduction

For initial skill development, example-based instruction has long been considered efficient as better learning outcomes are often achieved with less investment of time and effort during acquisition (e.g., Atkinson, Derry, Renkl, & Wortham, 2000; Renkl, 2014). While within example-based learning, a distinction can be made between two kinds of example-based instructions: worked examples and modelling examples, in recent years due to the rapid advances in technology, the lines between these two types of instruction have become less clear-cut and the combination of the features of both in video-based examples are being explored (van Gog & Rummel, 2010).

The initial focus of example-based research was on correct examples (Sweller, Van Merriënboer, & Paas, 1998; 2019; Van Gog & Rummel, 2010), however recent studies have increasingly started to investigate the effectiveness of incorporating erroneous examples in the instruction of various domains (e.g. Cattaneo & Bodrini, 2017; Huang, 2017; McLaren, Adams & Mayer, 2015; Heemsoth & Heinze, 2014). While correct examples provide support to learn correct concepts and procedures, erroneous examples were found to force students to attend to critical problem features and can help weaken faulty knowledge (Booth, Lange, Koedinger, & Newton, 2013).

Moreover, prior research found that error inclusive instruction can result in better management of errors both from an emotional aspect in dealing with errors (Keith & Frese, 2005) and from error knowledge aspect by enforcing reflection and analysis which help learners build a mental model including both correct and incorrect solutions (Heemsoth & Heinze, 2016). Although erroneous examples are also likely to affect emotional reaction which may influence the learning outcome (e.g. Tulis, Steuer, Dresel, 2016), the effect of example-based instruction on emotions has so far been ignored.

Despite these potential benefits, the outcome of knowledge gains greatly varied in these studies, which could be attributed to the heterogeneity in the example design. Questions could be raised regarding the design variants that may contribute to these mixed outcomes such as the type of explanation provided for the erroneous example or the variation in the presentation of examples in the learning environment. Example design where learner needs to explain the error without much scaffold was found to induce a higher level of processing demands, specifically, for low prior knowledge learners (Große, & Renkl, 2007). Providing support for error handling, therefore, appears to be important to avoid the risk of overtaxing students' cognitive processing.

Regarding the presentation of examples, research suggests that correct examples should be presented before exposure to incorrect ones to facilitate the acquisition of foundational knowledge (Heemsoth & Heinze, 2014). However, instructional methods such as productive failure (Kapur, 2012) suggest otherwise, arguing for the benefits of challenging learners with a problem space before direct instruction. Nevertheless, as no previous example-based study investigated if varying sequences of correct and incorrect examples would make a

difference, it is unclear whether the presentation order has any impact on learning outcome. The present study thus investigates the effect of presentation order of examples on learning a procedure.

Besides the cognitive effects, motivational processes may also play an important role in learning from examples. Self-efficacy, a key construct of motivation, can keep learners' task-oriented and committed to achieving their goal (Bandura, 2010). Therefore, instructions should aim to promote its development. And while erroneous examples may have an impact on self-efficacy, it is surprisingly under-researched in example-based learning.

Altogether the goal of this study is to investigate the effects of presentation order of examples on engagement, self-efficacy, emotional reactions to error, error analysis and task performance. This will be done by using an experimental setup that systematically varies the sequencing of correct and incorrect video-based examples (i.e. correct-incorrect and incorrect-correct vs. correct-correct). To optimize the example design, detailed error management information will be given for the erroneous examples and instructional explanation will demonstrate the tasks for all groups. As the study is video-based thus runs the risk of passive processing, video-engagement will be recorded to obtain a measure of control for time-on-task with the video and to discover whether students process the videos sufficiently.

2. Theoretical framework

2.1. Example based learning

Example-based instruction has been viewed for a long time as an effective method for learning new skills. Two types of example-based learning can be distinguished: worked examples and modelling examples. Worked examples originate from cognitive load theory (Sweller & Cooper, 1985) and provide students with a written account of a problem and stepwise solution. Modelling examples originate from Bandura's social learning theory (1986), and usually provide a demonstrated task performance to the learner. In recent years, these two types have become less distinct as video-based examples combining features of both have been increasingly used (van Gog & Rummel, 2010). While research initially focused on correct examples, there has been a growing interest in the effect of the combination of correct and incorrect examples on acquiring new knowledge and skills in diverse domains.

Correct and erroneous examples

Correct examples present the learner with a problem statement and the steps to reach the final solution (Sweller, van Merriënboer, & Paas, 2019). In initial skill acquisition learners can resort to slow, error-prone problem solving that is driven by superficial strategies (Renkl, 2014). Correct examples can relieve this process as learners study multiple of them and can focus their attention on the relevant information before trying to solve problems on their own (Sweller, van Merriënboer, & Paas, 2019). Empirical research on using correct examples has shown significant benefit for initial knowledge acquisition with less investment of time and effort (Atkinson, Derry, Renkl & Wortham, 2000; Sweller & Cooper, 1985).

Erroneous examples also present the learner with a problem and its stepwise solution, except one or two of the steps are flawed (Adams et al., 2014). Recently, as multiple benefits of the use erroneous examples have been found, an increasing number of researches focused on combining correct and incorrect - mixed - examples (e.g. Durkin & Rittle-Johnson, 2012; Große & Renkl, 2007). Using erroneous examples can engage learners in deeper learning processing by requiring the learner to take the time to reflect and understand the error (Adams et al, 2014). Moreover, comparison of incorrect to correct examples was found to support the uncovering and replacing of faulty knowledge (Durkin & Rittle-Johnson, 2012; Zhao & Acosta-Tello, 2016). Additionally, incorrect examples can support the development of error-anticipatory knowledge so learners can avoid wrong solution methods (Cattaneo, & Boldrini, 2017) and support the development of error detection and analysis skills (Tsovaltzi et al., 2010).

Despite these benefits, the outcomes of knowledge development were mixed in these studies. Some reported increase in knowledge gain (Adams et al., 2014; Durkin & Rittle-Johnson, 2012) some reported no effect (Barbieri & Booth, 2016; Isotani et al., 2011) and some had better outcomes when only correct examples were used (Große & Renkl, 2007).

One of the possible reasons why these studies resulted in mixed outcomes can be prior knowledge which was found to interact with the effectiveness of examples. Learners with high prior knowledge may benefit more from erroneous examples (Zhao and Acosta-Tello, 2016; Heemsoth and Heinze, 2014; Große and Renkl, 2007). Those with low prior knowledge appear to benefit when errors were highlighted for them (Barbieri & Booth, 2016). An often-used example design that may be partially a reason for mixed outcome, can require learners to explain incorrect examples (Istoni et al., 2010; Große & Renkl, 2007; Renkl, 1997). This however can be taxing on cognitive sources, and it ultimately can impair learning for low prior knowledge learners (Große & Renkl, 2007). Prior studies found that incorrect example combined with detailed error analysis and correction was conducive to learning (Domuracki, Wong, Olivieri, and Grierson, 2015; Huang, 2017; Kopp, Stark, Kühne-Eversmann, & Fischer, 2009; Stark, Kopp & Fischer, 2008;). This indicate that to avoid overtaxing students, explaining the error in details and its correction to the learner (e.g. Tsovaltzi et al., 2012) can be necessary and for this instructional explanation can be considered (see in Wittwer & Renkl, 2010).

While the above outlines the important considerations for example design optimization, it remains unclear if other design aspect such is the integration of correct and incorrect solutions in the examples, and more specifically *the presentation order of the examples,* affect learning. Prior research suggests that receiving correct examples first can be beneficial for acquiring conceptual knowledge and for learning to execute the right action sequences (Große & Renkl, 2007; Heemsoth & Heinze, 2014;). This foundation can be especially useful for learners with low prior knowledge before trying to process incorrect examples. In contrast, instructional methods such as productive failure (Kapur, 2012) suggest that confronting learners with problem-solving (in this case, incorrect example first) prior to explicit instruction can help to activate learner's prior knowledge or raise awareness to the underlying deep feature (Loibl, Roll & Rummel, 2016.) So, when the subsequent instruction addresses the same feature, learners may pay more attention which can result in increased conceptual understanding (Kapur, 2012) and when combined with practice increased procedural fluency as well (Loibl, Tillema, Rummel, & van Gog, 2020).

In empirical research, the presentation order of examples varied a lot, but only a few studies adopted a mixed approach of presenting both correct and incorrect examples. For example, Große and Renkl (2007), in the domain of probability, adopted a mixed example design with correct example preceding the incorrect one. This set up was combined with variations in error highlights and self-explanation prompts. The examples were shown in strict order so learners could not go back and forth between the correct and incorrect solutions to compare them which may have impeded learning for low prior knowledge learners. Likewise, Zhang & Tello-Acosta (2016) for teaching mathematics, used a design where correct solutions were followed by erroneous ones combined with varying levels of error analysis support. Mixed example presentation benefited learners more than correct examples only, but no difference between the two mixed example conditions was found.

Durkin & Rittle-Johnson (2012) in the domain of mathematics, chose a mixed examples design where correct and incorrect solutions were presented simultaneously, side by side. This allowed learners to compare correct to incorrect examples and make inferences without having to keep the correct solution in mind. Consequently, the mixed example condition helped students learn the correct procedure and concepts more than the correct only condition.

In sum, while the empirical studies show quite a variation in design, no research attempted to investigate whether presenting erroneous solutions first or second would make a difference in the learning process. Based on the premise of benefits on presentation order guidelines outlined previously, this study adopts a mixed example design where learners will be given either correct then incorrect or incorrect then correct video-based examples. Contrary to prior studies, instead of problem-solving, the examples will concentrate on teaching a software procedure. The video designs will be optimized by providing multiple examples for the same procedure. To further support learning, detailed error explanation (error detection, identification, correction) will be given to erroneous examples and instructional explanation will demonstrate the tasks for all groups. Additionally, to equalize prior knowledge, pre-training (see Mayer & Pilegard, 2014) will be provided. Lastly, practice opportunity will be given after each set of video example to enhance procedural fluency.

2.2. Examples and Engagement

Sufficient engagement with the instructional material is a key part of the learning process. As this study is video-based, it is important to review how mixed examples affect engagement and how this would work in a video-based environment.

Learner engagement can be defined as “students putting time, energy, thought, effort, and, to some extent, feelings into their learning” (Dixson, 2015). The time engaged with the content can be further explained as the time that learners appear to be paying attention to material that has instructional goals (Berliner, 1990). Educational research has found that aspects of learner engagement such as time on task and quality of effort are positively correlated to desirable learning outcomes (see Trowler & Trowler, 2010) therefore keeping learners engaged is an important aspect to be considered in order to make the learning process effective. Learning environment, in this case video, can also have an influence on engagement. While videos may invite a more passive processing (Salomon, 1984) according to Guo, Kim & Robbins (2014) when the videos are kept shorter (<6 min), more engagement with the learning content can be expected.

Empirical research on how example-based instruction affect learner engagement are scarce. While there growing number of erroneous/mixed example-based research (e.g. Adams et al, 2014; Cattaneo & Bodrini, 2017; Domuracki et al, 2015; Hoogerheide, Loyens, van Gog, 2014; Huang, 2017; Stark, Kopp & Fischer, 2009), very few studies examined how

learners interact with these examples. Stark, Kopp & Fischer (2009) investigated which part of the erroneous example learners engaged the most with and found that elaborated feedback on erroneous examples received more attention than actual erroneous examples. Kopp and Stark (2020) found that erroneous examples group worked longer than students in the correct example group, but this extra engagement was not associated with knowledge gain. Huang (2017) measured the time students spent on either worked example or video example and found video-based peer modelling group spent significantly more time on the examples than the other groups. While this extra time resulted in slightly higher task performance, video modelling groups also experienced higher cognitive load which can be due to the video-based example format. This suggests that engagement may not only measures the time learners spend on processing instruction but may also be an indicator of effectiveness of design and the learning environment.

To conclude, while engagement with the learning material is essential, little is known on how mixed examples affects this engagement. A possibility to maximize engagement is to keep video examples shorter. To gauge insight into the learner's interaction with the video examples, this study will measure total playtime to understand how long the videos will be processed including any pause and replay, unique playtime to explore whether participants watch the whole of the video or just some of it and whether the users needed to replay.

2.3. Examples and Self-efficacy

Self-efficacy is one of the key factors of motivation in social learning theory (Bandura, 1986). Perceived self-efficacy can be defined as the individual's confidence in their ability to set goals, organize and perform the behaviour necessary to achieve the goal or produce an outcome (Bandura, 2010). The stronger one's perceived self-efficacy, the more effective they are in following through the set course of actions (Bandura, 2010). In modelling examples, observing another person successfully performing a task can increase the learner's belief in their own ability to succeed in a similar task (Bandura, 1986). Although the importance of self-efficacy has been well researched in education (Schunk, 1996, 1991; Zimmermann, 2000), studies on how example-based learning affects self-efficacy have been scarce (van Gog & Rummel, 2010).

Van Harsel, Hoogerheide, Verkoeijen and van Gog (2019) over two experiments examined the effects of different examples and problem-solving sequences on motivational aspects of learning a mathematical task. For experiment one, the condition with correct example only resulted in the highest increase in self-efficacy, while in experiment two, correct example combined with problem solving and correct example only increased significantly self-efficacy. Huang (2017) compared four groups, a correct and an incorrect worked example groups to an expert and a peer modelling groups and measure the effect of those on self-efficacy. Self-efficacy beliefs increased in all conditions, and significantly stronger for both modelling examples. Tsovaltzi and al. (2012) compared three conditions to

measure self-efficacy: problems solving, erroneous examples without help or with error information help. Subsequently, erroneous examples with error information help reported the highest level of self-efficacy. Struve and Wandke (2009) investigated the learning of the use a ticket vending machine, comparing correct examples only group only and guided error training group. In the latter condition, common errors were included in the training, and users were guided to detect, diagnose, and correct these errors. Both experiment groups had resulted in increased self-efficacy following.

These above studies show that example-based learning, in general, can increase self-efficacy regardless of whether correct or erroneous is presented. Nevertheless, it is important to further investigate self-efficacy to understand more about how mixed examples contribute to its development. Mixed example presentations can make the task look feasible thus learners believe they are capable of the same performance and resulting in increased self-efficacy. However, they can also make the task look more complicated thus decreasing learners' perception of their own ability.

2.4. Examples and Emotional reactions to error

In the overall learning process, emotions play an important role. To understand how mixed examples may affect emotions, it is important to explore the role of emotions in learning, and how errors during the process may influence these.

Emotions can be defined as a complex, brief state of feelings that are brought about in response to and in interaction with a triggering event (Lazarus, 1991; Scherer, 2000, p.137) and can be categorized by valence (positive or negative) and activating quality (activating or deactivating) (Pekrun, Goetz, Titz & Perry, 2002). Positive emotions were generally found to facilitate learning, whereas negative emotions were found to hinder performance (Pekrun, Lichtenfeld, Marsh, Murayama, & Goetz, 2017). While error experiences are often associated with negative emotions (Melis, 2004), errors can trigger different emotional reactions from students (Tulis, Steuer, & Dresel, 2016). The emotion the learners react with can be influenced by their assessment of the relevance of the error regarding their goal and their internal resources to deal with error, such as perceived ability to do the task (Tulis, Steuer, & Dresel, 2016). Favourable outcome can trigger positive emotions and learners are likely to engage in task related effort, but in case of unfavourable outcome, negative emotions can emerge which may lead to disengagement from the task (Carver and Scheier, 1990). When errors are framed as a natural part of the learning process during instruction, it was found to help developing a positive perspective of errors which improve how learners manage their emotional reactions to them (Keith & Frese, 2005).

Example-based research has so far largely ignored investigating the role of emotions in learning from erroneous or mixed examples (Van der Meij & Flacke, 2020). Literature research has located only one study by Richey and al. (2019) who have explored the role of confrustration, a combination of confusion and frustration, induced by erroneous examples

for mathematics among 5th and 6th-grade students. Students in erroneous example groups experienced higher levels of confrustration but it did not positively influence immediate learning. However, delayed post-test results show that despite greater confrustration levels, erroneous groups did learn more as they outperformed the problem-solving condition. This suggests that erroneous examples may trigger rather negative emotions, but this may not necessarily be at the detriment of task performance.

To conclude, emotions seem inevitable in the learning process and emotion set off by errors can affect the learning processes. This study will demonstrate the error of someone else and investigate whether observing it affects learner emotions to error experience and if so, what emotion is triggered. Instead of looking at specific emotions, the study focuses on their value (i.e., positive, neutral, negative). Additionally, the relationship between emotional reaction and task performance will also be explored. No prior research has investigated this therefore the current study can allow us to gain insight into this aspect.

2.5. Examples and Error knowledge through Error Analysis

The core assumption of learning from errors is that error helps to develop a comprehensive mental model which includes knowledge about not only correct concepts and strategies, but also incorrect concepts and strategies called negative knowledge (Gartmeier, Bauer, Gruber & Heid, 2008). This model is developed by contrasting erroneous and correct solutions (Heemsoth & Heinze, 2014; Klein, Otto, Fischer & Stark, 2019) but whether the students can learn from this contrast is mediated by the level of error reflection and analysis they engage in (Klein, Otto, Fischer & Stark, 2019). Reflection entails a process of re-examination of the error that just happened (Gartmeier, Bauer, Gruber & Heid, 2008). Analysis entails the learner attempt to understand what was done incorrectly, why it was incorrect and what would be the correct approach in the specific context, so they can build a mental representation of the error (Klein, et al, 2019). This then can help the development of avoidance strategies and alternatives actions for future, similar situations (GroBe & Renkl, 2007; Heemsoth & Heinze, 2014).

In example-based learning, demonstrating erroneous examples has the advantage that learners do not need to make the error but can observe the demonstration of erroneous examples and their correction from which knowledge about error and avoidance strategies can be acquired (Klopp & Stark, 2020). Prior example-based research explored whether incorrect examples supported the development of negative knowledge through assessment of error detection, analysis and correction tasks (e.g. Heemsoth & Heinze, 2014; Klein et al, 2019; Tsovaltzi et al., 2012). Tsovaltzi and al. (2012) found that erroneous examples with elaborate error explanation feedback improve learners' error detection, explanation, and error awareness skills. Although multiple studies refer to the importance of error analysis processes prompted by erroneous examples, so far, the quality of error analytical skills that demonstrated incorrect examples can develop has not been explicitly investigated.

To conclude, a comprehensive model that includes correct and incorrect strategies is expected to develop from error experiences that are scrutinized through reflection and analysis. Having error analysis processes demonstrated to the learner by an expert can allow the development of the aforementioned comprehensive model but the level of error analysis the learner engages in while observing influence if they can learn from the incorrect example. Therefore it is important to explore how the presentation order of examples affect the development and the quality of error analytical skills and whether the development of these skills influence the task performance

3. Research questions

In order to guide this research, the following research questions are posed:

Research question 1: *What is the effect of presentation order of examples on video engagement?*

Participants must engage with the videos sufficiently in order to learn from them (Guo, Kim & Robin, 2014). To gain insight into video engagement unique play rate, a proxy measure which indicates the percentage of the videos that have been set in play mode at least once, was recorded. Additionally, total playtime a measurement for the overall processing of the videos and replays were measured. As little is known of how example-based learning affects engagement, no differences between conditions is expected.

Research question 2: *What is the effect of presentation order of examples on self-efficacy development?*

Self-efficacy, the learner's belief in their own ability to succeed, can increase by observing task demonstration (Bandura, 1986). Based on the existing findings outlined in the theoretical framework (e.g. Huang, 2017; Struve & Wandke, 2009; Tsovaltsi et al., 2012) it is expected that all three conditions will increase learners' self-efficacy. No difference between the conditions is expected.

Research question 3*: What is the effect of the presentation order of examples on development of emotional reaction in relation to errors?*

Literature on emotions suggest that (mainly self-made) errors can trigger more negative emotions from learners which may not be beneficial for learning (Melis, 2004; Zhao, 2011). However, due to the lack of empirical research on how example-based learning influences learners' affective reaction, no difference among the conditions is expected.

Research question 4: *What is the effect of the presentation order of examples on task performance and whether emotional reaction, and error analysis influence this outcome?*

Sub question 1: *What is the effect of presentation order of example on task performance*?

As outlined in the theoretical framework, studies that included mixed examples had varied outcomes on knowledge gain. Moreover, presentation order of examples as used in this study has not been explored, therefore no specific hypothesis is tested, and no differences between the conditions are expected.

Sub question 2*: Is there a relationship between emotional reaction to error and task performance*?

Emotion set off by (mainly self-made) errors can affect the learning processes but in example-based learning there is a knowledge gap of the relation between emotions and knowledge gain. Therefore, no specific hypotheses are tested.

Sub question 3*: What is the effect of order of examples on error analytical skill development*?

Sub question 4: *Is there a relationship between error analytical skill and task performance?*

Based on theoretical framework learning from (self-made) errors can develop better knowledge of both correct and incorrect strategies and improved error reflection and analytical skills (Gartmeier, Bauer, Gruber & Heid, 2008). Due to lack of research on how video example-based support the development of error analytical skills, no difference among the conditions is expected. Additionally, this study sets out to explore whether error analytical skill development influences task performance. No specific hypotheses are tested.

4. Method

4.1. Participants

The participants of the study (*N*=73) came from various study programmes of the University of Twente. The mean age of male (*n*=17) and female (*n*=56) students was 22.44 years (*SD*=5.42). Students were evenly but randomly assigned to conditions. In the end, the number of participants were 24 in the control, 25 in the correct-incorrect examples, and 24 participants in the incorrect- correct example condition. A Chi-squared test showed that gender (*X2* (2, *N* = 73) = 1.06-, *p* = .588) was randomly distributed. The Ethics committee of the University of Twente was asked for approval to work for student's participation in this study. Additionally, all participants signed a consent form. To reward participation, students could either receive a SONA credit or a 10-euro gift card.

Table 1. Distribution of male and females per condition

Condition	Male (freq.)	Female (freq.)
Correct-Correct (*n*=24)	4	20
Correct-Incorrect (*n*=25)	6	19
Incorrect- correct (*n*=24)	7	17
Total (N=73)	*17*	*56*

4.2. Research Design

In order to answer the research questions, a quantitative experimental research with pre-test-intervention-post-test design was conducted. Engagement, self-efficacy, emotional reaction and learning from errors were all dependent variables, and the varying presentation order of examples was the independent variable. For measurement of engagement video log files were collected during the intervention. To collect data for self-efficacy, emotional reaction and error analytical skill development, two moments of measures were used: 1. pre-test questionnaires as a starting point and 2. post-test questionnaires for comparison. To measure knowledge development four tests were administered: during training practice tasks, and after training, a retention test, transfer test and error management multiple choice questionnaire. In the current study, two experimental groups (correct-incorrect and incorrect – correct examples) and one control group (correct-correct examples) were created.

4.3. Instruments

4.3.1. Instructional materials

Instructional Videos. For each condition four videos about basic Excel features were developed. The target group were bachelor's students with little to no experience in Excel. Students' data collection for their thesis or course work is often done online, and the Excel features selected for the videos were relevant for the preparation of the downloaded, unformatted dataset before the use of statistical software. For correct examples, a competition analysis was carried out reviewing existing Youtube videos, see Appendix C. The erroneous examples focused on underlying logic of the specific Excel feature that beginner users may ignore.

All four videos had a 3-part structure: first the preview introduced the user to the Excel feature, followed by the demonstration of two examples of the same feature. In each preview, the before and after image of the task result was illustrated (Van der Meij & Gellevij, 2004) , see Figure 1. In addition, two smiley icons were used to make clear what is a least and most desirable outcome. Each example was problem centered. The examples started with a short, problem statement related to data collection., followed by a stepwise demonstration of the use of the feature to resolve the problem. The narrative of the problem statements slightly varied depending on whether the error example came first or second. In the erroneous videos, the erroneous step was built in the continuous flow of the demonstration as it would happen in real life. To help learning from the error, the narration pointed out the error occurrence, explained what went wrong and why that was a mistake (diagnosis), and what the correct solution process was for the erroneous step (correction) (van der Meij & Carroll, 1995). During task completion, the whole screen was shown to support the development of mental image of the interface and show any changes on screen (Van der Meij & Gellevij, 2004) and support better recall of the procedural steps. At the end of each video the participants were invited by the narrator to practice the newly acquired skill. All spoken and on-screen texts were in English, sharing the same female voice-over.

Video 1 dealt with the use of Text to Columns (length in seconds per condition CC = 258.67, CI =257, IC=289); the erroneous example focused on delimiters (e.g. comma, semi-colon) the feature uses for splitting up cell content. Video 2 featured adding Filter buttons and their various uses (length of videos in seconds per condition CC = 247, CI =314, IC=314); the incorrect example focused on why the application of filtering and sorting can shift rows thus mixing up participants' data. Video 3 dealt with the Replace feature (length of videos in seconds per condition CC = 201, CI =268, IC=268), the erroneous example focused on the selection of the occurrence which can invisibly replace unintended data values in the whole dataset. Video 4 featured the use of Upper and Lower formula (length of videos in seconds per condition CC = 344, CI =379, IC=379) The video included subtasks such as a). adding extra columns for the formula; b.) using copy paste text feature for formula transformation and c.) deleting the original variable column to avoid duplicated variables; the erroneous example focused on the cell referencing and formula transformation to normal text. Overall,

the erroneous videos were longer due to this additional information about error management.

The overall video design followed the guidelines from the Demonstration based training model which complements observational learning processes with multimedia principles (Brar & van der Meij, 2017). Cueing, in the form of arrows to guide the user's attention on the screen and circles were used to signal location of objects (Mautone & Mayer, 2010). To support retention and allow reflection, the video content was segmented by pauses where no new additional information was presented. Pauses were found to increase learning when information is dynamically represented (Spanjers, van Gog, Wouters., & van Merriënboer, 2012). The narration used was conversational style which was found to affect motivational processes significantly (Reichelt, Kammerer, Niegemann, & Zander, 2014). Additionally, the tasks demonstrated were selected to represent real and relevant tasks for university students, allowing to anchor the task domain (van der Meij & Carrol, 1995). Lastly following guidelines from Guo, Kim and Robin (2014) most of the videos were kept short (<6).

Website/Graasp. The website Graasp provided access to all videos to the participants. A toolbar visible on the left side of the website showed the order of the videos to be watched. After selecting a video, a still showing the preview and the title of the video appeared. Students could start the video by selecting the play button from a standard toolbar that allowed full user control of the video. Users could start, stop, forward and rewind the video at their convenience.

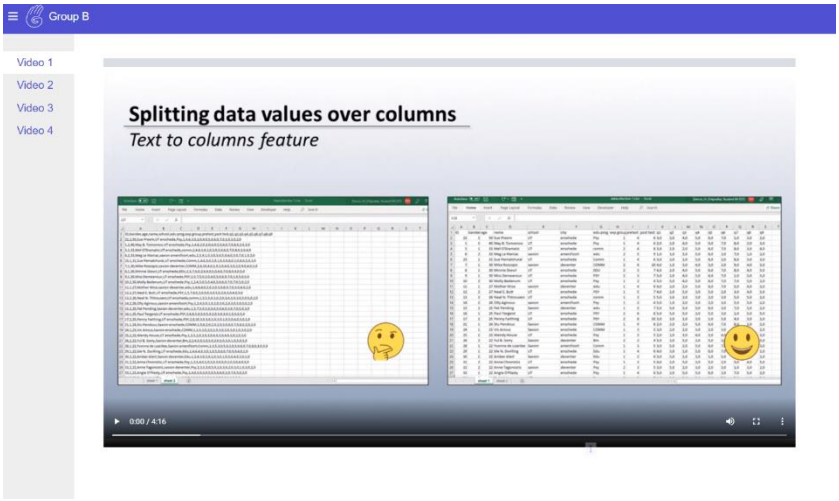

Figure 1. Preview of video 1 in Graasp

Instructional Booklets. Paper booklets were used to guide the participants actions and behaviour through the entire experiment session (see Appendix A). The instructional booklet included a standardized explanation about the procedure, the consent form, the pre-and post-knowledge test, questionnaire on perceived self-efficacy, error cognition /metacognition and emotional reaction measures. The only variation in the instructional

booklet for the different research conditions was the Graasp login address the participants had to use to access the videos.

Pre-training document. A paper-based pre-training document was used to provide a general overview of basic concepts of Excel (see Appendix B). The pre-training included visuals and a short explanation of basic Excel concepts (set up of Excel interface, type of data inputs, formulas) and it was the same for all three conditions.

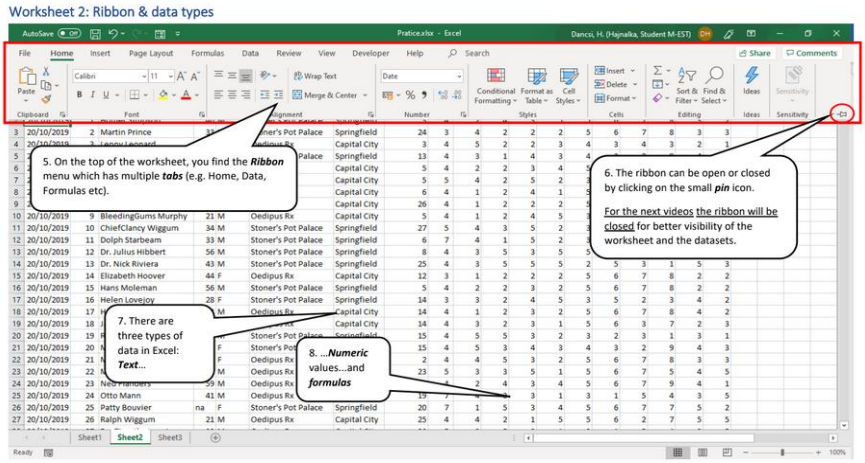

Figure 2. Example from the pre-training document

4.3.2. Measurement instruments

Task performance test. Task performance test included practice, retention, transfer tests and error management multiple choice questionnaire. Overall, these four subscales resulted in low internal consistency which can be attributed to the low number of test items (Tavakol & Dennick, 2011), meaning that each subscale consisted of 3 to 5 items. Additionally, the purpose of the task performance test was to cover all features presented in the videos rather than to maximize internal consistency.

Practice included four question items, each were developed based on the use of the four Excel features and the procedures shown in the videos (see Appendix A). The tasks were problem centred and required the same procedure shown in the videos. For the completion of the practice test, an offline Excel file was also created, including three mock datasets with different variables from the videos. Each correct item was scored 1 point. Total points participants could gain were 4 points. The internal consistency reliability of the test was .11.

Practice 2. Displaying only the result of female employees of Stoner's Pot Palace company

To complete the practice for Video 2, follow the below steps. Do not spend more than app. 2 -3 minutes on the practice.

1. Go back to your version of Practice file
2. Go to Sheet2
3. Add filters to your dataset
4. Filter on company column to see "Stoner's Pot Palace" only
5. Also Filter on gender to only see women (F as female in the dataset)
6. Save your current work

When you are ready with practice, move onto the next step.

Figure 3. Example from the practice task

Retention test had four items, each covered the same feature and procedure shown in the videos (see Appendix A). Retention test items were problem cantered and measured the participants' adaption of procedural knowledge learned during the intervention. An offline Excel file was developed including four mock datasets and was used for completion of the retention test. In this file, the first two datasets were used for retention items, and other two datasets for transfer test items. For each task the current vs. expected outcome was displayed by images, see Figure 4. Overall, a total of 4 points could be gained from the test. The internal consistency reliability of the test was .28.

1. **Go to Sheet1 in your version of the Test document. You will use the dataset in this sheet to complete the task for Q1.**

Q1. Make this dataset usable for analysis by splitting it up to columns. For expected result of the task, see below the before and after image example. When you are finished, save your work in your current document.

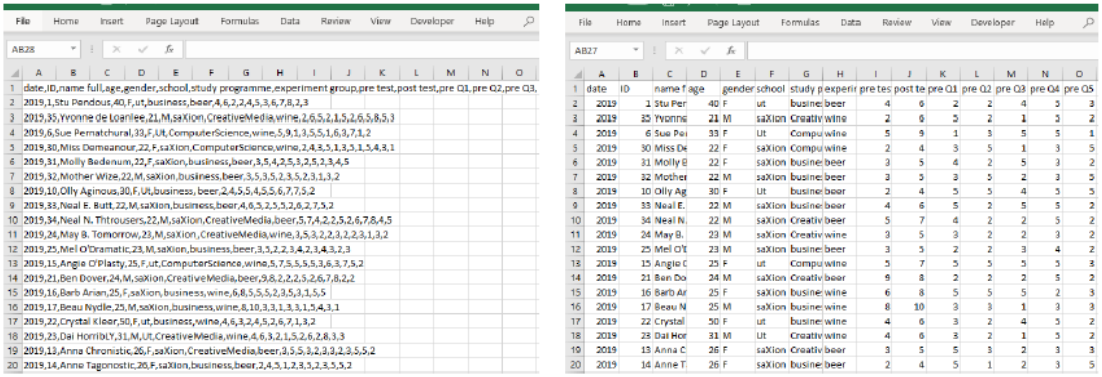

Figure 4. Example of a Retention test item

Transfer test included three test items on untrained Excel tasks (see Appendix A). The procedural knowledge was the same as in the video, but users had to use for instance a different delimiter (i.e. semi-colon) or formulae than what they had shown in the video. The expected outcome of the tasks was displayed by images under each question item, the same way as for retention tests. For completion of the transfer test, the same Excel document

that was used as for the retention test. For each task the current vs. expected outcome was displayed by images, see Figure 5. Total points participants could gain were 3 points. The internal consistency reliability of the transfer test was .53.

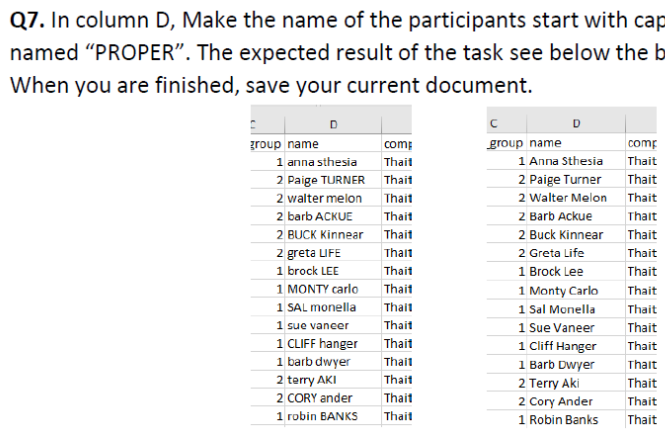

Figure 5. Example of a Transfer test item

Error management questionnaire measured the participants' error diagnosis and correction skills gained from the procedural knowledge presented in the videos (see Appendix A). It included five multiple choice question items with five alternatives answer for each question. The test was paper based and included in the Instructional booklet. The test scoring was worth a total of 5 points. The internal consistency reliability of the test was .73.

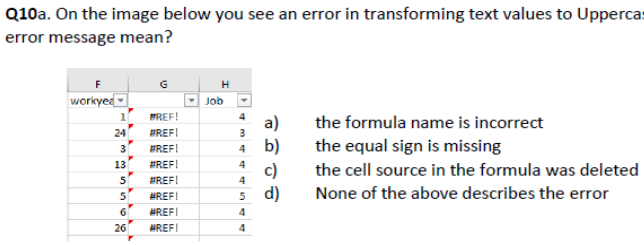

Figure 6. Example of an Error management multiple choice question item

Prior experience measures. One item was developed to assess prior domain knowledge ("Please rate your experience in working with Excel") and prior experience with errors in Excel ("Please rate your experience in error handling with Excel"). The items were offline included in the Instructional Booklet. Response was given on a 10-point Likert scale, with values ranging from weak (1) to excellent (10).

User Logs. To measure participants' interactions with the videos, play time, unique play time and replay time was abstracted from the website, Graasp, that captured participants' time-stamped actions on each video. Because the erroneous videos are longer, for each user log, the mean value was calculated. Playtime is the total length that the videos were open (including replays and pauses). Replays can be caused by a missed information the user

notices or the need for further information, while pauses can be a sign of a need for reflection on the content (van der Meij & Dunkel, 2020). Unique play time refers to the duration of the non-overlapping moments for a video. It was indicated as a percentage of the total number of seconds spent in a video. For example, if a participant watched 100 seconds of the first video of the incorrect correct group (230 seconds),only 100 seconds was distinctly played, and the unique play rate was 100/230=43.5%. The maximum score was 100% which means that every second of the video was played. The minimum score was 0% meaning the video was never set in play mode.

Self-efficacy questionnaire*.* A paper questionnaire measured perceived self-efficacy (see Appendix A). The questionnaire consists of five questions on a student's perceived ability to use the Excel features presented in the videos. Based on Bandura's (2006) recommendation, the items followed a uniform stem of what the participant *can* do specific in the domain ("How well can you..."). The first two items measured general skills in Excel (e.g. "Set up a dataset"). The next four items presented specific Excel skills related to the video content (e.g. "Use Filters"). Responses were given on a 7-point Likert scale, with values ranging from weak (1) to excellent (7). The internal consistency reliability of the scale was .92 and .84 for pre-test measurement and post-test measurement, respectively.

Emotional reaction to error and Error analytical skill questionnaire. A paper questionnaire measured the valence of emotional reaction to errors and the depth and quality of the participants' skills of error reflection and analysis (see Appendix A). For their design, two clusters, namely emotions and thinking of errors, were adapted from the Error Orientation Questionnaire by Rybowiak, Garst, Frese, and Batini (1999). The items in both questionnaires followed a uniform stem ("In Excel, when an error occurs...") with six questions on participants' perceived emotional reaction to errors (" I feel annoyed"; "I feel sad") and six questions on their own perceived cognitive effort following error detection (" I think about possible causes …"; "I try to solve the error in any way I can.."). Responses were given on a 7-point Likert scale, with values ranging from strongly disagree (1) to strongly agree (7). The internal consistency reliability of the scale for the emotional reaction questionnaire items were .65 and .71 and for the error analytical skill items were .71 and .74 for pre-test measurement and post-test measurement, respectively.

4.4. Procedure

Overall, 48 individual experiment sessions were conducted during a five weeks period. Participation in the experiment was voluntary. Students could sign up for participation using the SONA system and through a Doodle invite that was advertised through various social media platforms. Participants were provided with laptops, the instructional booklet training document, USB sticks containing two Excel documents for practice and post-test knowledge assessment, pens, and earplugs. Every participant watched the same number of videos and completed the same knowledge tests and questionnaires.

During the experiment, participants were instructed to follow the instructional booklet. First, the booklet instructed them to review a pre-training document, then to fill out a questionnaire about prior knowledge, self-efficacy, error analytical skill and emotional reaction to error. Thereafter the participants had to use a link provided in the instructional booklet to log into Graasps which hosted the videos. Each video segment was started manually by the participant, and participants could re-watch the videos as many times as they needed to. After each segment, the participants manually stopped the video and did the practice exercise. Participants could review the videos during practice.

Once all videos were viewed, and practice completed, the participants were no longer allowed to re-watch the videos. Participants had thirty minutes to finish the post-intervention assessment. Every participant finished before the provided time frame. They started with the self-efficacy, error analytical skill and emotional reaction questionnaire and then completing the retention, transfer and error management tests. The post knowledge test was completed using an offline Excel workbook from the USB stick. At the end of the assessment participants were instructed to save one copy of the practice and assessment Excel file back onto the USB stick provided at the beginning of the session. The experiment was completed at the own pace of the participants. The time average spent on an experiment session was one hour.

4.5. Data analysis

This paragraph describes the analysis of the incoming data. Average scores were computed for each dependent variable. To test for normality of distribution Shapiro Wilk test was used. For all analyses, testing was two-tailed with alpha set at 0.05 and was used to report on significance. For effect size the r-statistic is reported (Field, 2013). This statistic tends to be qualified as small for r=0.10, medium for r=0.30, and large for r=0.50 (Cohen, 1992).

Demographics. Data was collected on participants' age, their prior domain knowledge, prior error experience. To measure whether demographics data are equal among conditions ANOVA test was performed and reported.

Engagement. The effect of condition on video engagement was analysed by comparing the playtime, unique playtime and replay time between the three conditions. The data was extracted from the video engagement application in the platform 'Graasp'. The assumptions on the normality of distribution and /or homogeneity of variance were tested and revealed that there were violations for normality and/or homogeneity of variance. Therefore, a non-parametric, Kruskal Wallis test was used and results are reported for these measurements.

Self-efficacy. The effect of condition on self-efficacy was analysed by comparing the difference of overall average means scores between pre and post intervention scores, and by contrasting the difference between the conditions. There were violations for normality

and/or homogeneity of variance therefore non-parametric tests (Wilcoxon sign rank test, and Kruskal Wallis) were used and results are reported accordingly.

Emotions. The effects of condition on emotional reaction to error was analysed by comparing the overall difference of means of the pre and post intervention, and by comparing the differences among the two experiment and control conditions. No violations for normality and/or homogeneity of variance was found therefore, paired T-test and ANOVA test were performed, and its results reported. Assumptions on sphericity are assumed due to having only two measurements.

Error analytical skill. The effects of condition on the development of perception of error analytical skills was interpreted by comparing the overall difference of means scores between pre and post intervention, and by comparing the difference between the conditions. The variable turned out to be non-normally distributed therefore Wilcoxon sign rank test, and Kruskal Wallis test was used and results are reported accordingly.

Task performance. The effect of condition on knowledge development was analysed by comparing the scores on practice, retention, transfer, and error diagnosis and correction multiple choice questions between the conditions. The assumptions on the normality of distribution and /or homogeneity of variance were tested and revealed that there were violations for normality and/or homogeneity of variance. The non-parametric, Kruskal Wallis test was used therefore and results are reported for these measurements.
To measure the influence of error analytical skill development on task performance, Spearman Rank correlation test was used, and results reported. Likewise, Spearman Rank correlation test was used to measure the relationship of emotions and task performance.

5. Results

This chapter comprises analysis of results. The data will be presented first starting with participants' demographic distribution, followed by the data regarding engagement, self-efficacy, emotions, learning from error, and in the final part, data concerning knowledge gains are presented.

5.1. Distribution of demographics

Table 2 shows the distribution of demographics among the three experiment conditions. Overall, four participants were excluded from the data used for the analysis of this study: one participant continued to engage with the videos during the knowledge test and three participants watched less than 50% of the videos. ANOVA test showed that age ($F(2,71) = .113$; $p = .893$), prior knowledge ($F(2,70) = .182$; $p = .834$) and prior error experience ($F(2,70) = .176$; $p = .839$) were all equally distributed among conditions. Spearman correlation did not reveal any significant correlation either between prior knowledge and knowledge test mean scores nor between prior error experience with Excel and the same knowledge test mean scores.

Table 2. Distribution of demographics

Condition	Age *M (SD)*	Prior knowledge *M (SD)*	Prior experience with error in Excel *M (SD)*
Correct-Correct (*n*=24, *n*=23 *)	22.79 (4.31)	3.48 (2.13)	2.29 (1.73)
Correct-Incorrect (*n*=25)	22.48 (7.73)	3.12 (1.92)	2.08 (1.45)
Incorrect-correct (*n*-24)	22.04 (3.29)	3.29 (2.12)	2.37 (2.12)
Totals (N=73)	*22.44(5.42)*	*3.29 (2.03)*	*2.25 (1.78)*

**The number of subjects for prior knowledge and prior experience with error in Excel respectively*

5.2. Engagement

The mean averages for Unique playtime, Total playtime, and Replays are shown in Table 3. The unique play time, a proxy for viewing, on average was over 90%. Kruskal Wallis test showed no significant differences in unique play time between the conditions on the unique play view ($H(2, N=73) = 4.137$, $p = .126$). The average of *total playtime* learners spent processing the videos including rewind and pause was 99 %. Kruskal Wallis test revealed no significant difference in total play time between the three conditions ($H(2, N=73) = .907$*, p = .636).* This suggests that all conditions spent an equal amount of time processing the videos. *Replay time* from the total playtime, was on average very low for each condition.

No significant difference in replay time was found between the conditions (*H(2, N*=73*)* = 1.894, *p* = .388).

Table 3. Video engagement in percentage per condition

	Unique playtime *M (SD*)	Total Play time *M (SD)*	Replays *M (SD)*
Correct-correct (*n*=24)	90.46% (12.67)	97.46% (16.54)	1.64% (4.93)
Correct-Incorrect (*n*=25)	94.84% (10.11)	102.20% (16.88)	1.80% (3.84)
Incorrect- correct (*n*=24)	93.00% (12.75)	97.92% (15.45)	0.56% (1.24)
Totals (N=73)	*92.79% (11.86)*	*99.23% (16.23)*	*1.34% (3.67)*

5.3. Self-efficacy

Table 4 presents the data for self-efficacy development. A Wilcoxon signed-rank test revealed a significant difference, with a large effect size, between the pre- and post-test self-efficacy levels (*Z* = -7.377; *p* < .001, r=.611). This means that on average participants' self-efficacy increased from before watching to videos (*M*=2.43*; SD*=1.44) to after having watched the videos (*M*=5.25*; SD*=0.98). Further analysis found no significant difference of self-efficacy development between the conditions (*H*(2, *N*=73) = .731, *p* = .694)

Table 4. Self-efficacy development per condition

Condition	Self-efficacy Before *M (SD)*	Self-efficacy After *M (SD)*
Correct-correct (*n*=24)	2.57 (1.57)	5.49 (*1.01*)
Correct-Incorrect (*n*=25)	2.33(1.48)	4.99 (0.98)
Incorrect- correct (*n*=24)	2.34(1.26)	5.27 (0.92)
Totals (N=73)	*2.41 (1.43)*	*5.25(0.98)*

Note: Scale values range from 1 to 7, with higher values meaning a more positive rating.

5.4. Emotional reactions to error

Table 5 presents the data for development of emotions in relation to error. A paired T-test revealed a significant difference, with a large effect size, between the overall average of pre- and post-test emotions (*t* = 6.484; *p* < .001; *r*=.607). This means that on average participants' emotional reaction to error become more positive from pre-test questionnaire (*M*=3.99*; SD*=0.99) to post-test questionnaire (*M*=3.44*; SD*=0.97). ANOVA test revealed no

significant difference in emotional development between three conditions $F(2, 70) = 1.238$, $p = .296$).

Table 5. Values of Emotional reaction to error per condition

	Emotion Reaction Before *M* (*SD*)	Emotion Reaction After *M (SD)*
Correct-correct (*n*=24)	4.11 (1.08)	3.51(1.03)
Correct-Incorrect (*n*=25)	3.99 (0.89)	3.62(0.91)
Incorrect- correct (*n*=24)	3.86 (1.02)	3.17(0.94)
Totals (N=73)	*3.99(0.99)*	*3.44(0.97)*

Note: Scale values range from 1 to 7, with higher values meaning a more negative rating.

5.5. Error analytical skill

Table 6 presents the data for development of perception of error analytical skills. Wilcoxon Sign tests reveal significant differences between overall pre- and post-test scores, with medium effect size ($T = -4.673$; $p < .001$; $r = .387$). This means that on average participants increased their error analytical skills from pre-test (M=4.41; SD=0.95) to post-test (M=4.88; SD=0.89). Kruskal Wallis test revealed no significant difference in error analytical skill development between the conditions $H(2, N = 70) = .048$, $p = .946$).

Table 6. Error analytical skill development per condition

	Error Analytical skill Before *M (SD*)	Error Analytical skill After *M (SD)*
Correct-correct (*n*=24)	4.50 (0.99)	4.99(0.95)
Correct-Incorrect (*n*=25)	4.43 (0.83)	4.84(0.81)
Incorrect- correct (*n*=24)	4.30(1.04)	4.82 (0.93)
Totals (N=73)	*4.41(0.95)*	*4.88(0.89)*

Note: Scale values range from 1 to 7, with higher values meaning a more positive rating.

5.6. Task performance

5.5.1. Effect of presentation order on task performance

Table 7 shows the overall score percentage on practice, retention, transfer, and error management MCQ tests. The overall mean score for practice was 96% which indicates that participants were able to complete nearly all tasks during the video training. The Kruskal

Wallis test found no significant difference of practice score among the three conditions (*H*(2, *N*=73) = *4.901, p = .086).*

The overall mean retention test score was high 89 %. Kruskal Wallis test revealed no significant difference among the three conditions (*H*(2, *N*=73) = 5.619, *p* = .060).

The 78% mean score on the knowledge test means participants did moderately well on this test. Kruskal Wallis test found no significant difference in transfer test scores among the three conditions (*H*(2, *N*=73) = 2.717, *p* = .257).

The overall mean error management test score was high 65 %. Kruskal-Wallis test found that there was a statistically significant difference between the conditions, *H*(2, *N*=73)= 8.866, *p*= .012. Further analysis revealed no significant difference between the two experimental conditions (*U*(49) = 283.00, *z*= -.355, *p* = .722) but both experimental conditions, correct-incorrect (*U*(49) = 174.00, *z* = -2.578, *p* = .010, *r*= .365) and incorrect correct (*U*(48) = 168.00, *z* = -2.539, *p* = .011, *r*= .350) groups' error management scores did show a significant difference from control condition. The effect size values pointed to a medium effect. This means that on average both experimental conditions did better with error diagnosis and correction tasks than the control condition.

Table 7. Total practice and task performance score (percentage) per condition

	Practice *M (SD)*	Retention test *M (SD)*	Transfer test *M (SD)*	Error management MCQ *M (SD)*
Correct-correct (*n*=24)	98.86(51.03)	92.71(11.60)	82.64 (23.30)	50.00(31.20)
Correct-Incorrect (*n*=25)	94.00(11.47)	82.50(20.73)	70.67(32.01)	72.80(28.21)
Incorrect- correct (*n*=24)	97.92(85.34)	94.27(12.76)	81.94(27.76)	73.33(32.66)
Totals (N=73)	*96.92 (85.34)*	*89.73 (16.32)*	*78.31 (28.15)*	*65.48 (32.19)*

5.5.2. Correlation between emotional reaction to error and task performance

Correlational analyses were used to examine the relationship between relationship between participants' emotional reaction to error and their task performance. A Spearman correlation revealed a strong, positive correlation between pre-test and post-test emotional reaction to error experience in all three groups (correct-correct *r* (24) = .711; *p* < .001; correct-incorrect *r* (25) = .705; *p* < .001; incorrect-correct *r*(24) = .725; *p* < .001). This relationship means that in all three conditions the more positive emotional reactions to errors were pre-test, the more positive these emotions became post-test.

Moreover, a strong, negative correlation was found between post-test emotional reaction and success on the transfer tasks in correct-incorrect experimental condition (r(25)= -.586; p = .003). This relationship indicates that as emotional reaction to error became less negative, transfer test score increased.

5.5.3. Correlation between error analytical skill and task performance

Correlational analyses were used to check the relationship between error analytical skills and task performance. A Spearman correlation revealed a moderate, positive correlation between pre-test and post-test error analytical skills the correct-correct group (r(24) = .467; p < .021;) and strong, positive relation in the two experiment conditions (correct-incorrect r (25) = .575; p < .003; incorrect-correct (r(24) = .538; p < .007). This means that the more error analytical skills were developed pre-test, the more these same skills increased post-test in all three conditions.

Moreover, a moderate, positive relation was revealed between pre-test error analytical skills and error management multiple choice test in the incorrect-correct group (r(24) = .454; p < .026). This positive relationship means that the more participants indicated good error analytical skills pre-test, the more error management test scores increased. Additionally, a strong, positive relation was found between the error analytical skills post intervention and the retention task performance in the correct-incorrect experimental condition (r(25) = .576; p < .003). This relationship indicates that as perceived error analytical skill increase, retention test scores also increase.

6. Discussion

Using a pre-post-test design in a controlled setting, this study aimed to find out the effect of presentation order of examples on video engagement, self-efficacy, emotional reaction to error; error analysis and task performance. To answer the research questions, the results of the current research will be compared to the insights from the theoretical framework, which is followed by suggestions for future research, and a brief explanation of how the findings of this study can be useful in science and practice.

6.1. Effects of presentation order of examples on engagement

Sufficient engagement with the learning content is a prerequisite to learning (van der Meij & Dunkel, 2020), therefore during the learning process, it should be maximised. As little is known of how video-based examples affect engagement, no differences between conditions were expected Overall, the recorded measures of unique play and total playtime showed that participants had engaged with a large proportion of all videos in all three groups.

The scores for unique play rates showed that on average participants watched over 90% of the videos. This suggests that the study satisfied a necessary condition for video effectiveness, namely enough engagement with the videos. Participants in both mixed examples conditions had slightly higher unique view rates than correct example condition, which could indicate that mixed examples have held the learner's attention longer than correct only example. Prior studies that measured time on task also found that incorrect examples take more time to process (Huang, 2017; Stark, & Kopp 2020).

In addition, the average total playtime was 99%, and only the correct-incorrect condition exceeded the duration of the videos by 20% on average. As the presence of pauses and replays can signal difficulties of understanding (van der Meij & Dunkel, 2020), the results of total engagement allow inferring that learners managed to understand the video after the first viewing, or that is at least for correct only and incorrect-correct conditions.

Replay rate on average was very low (1.37%), which means that most participants did not review videos again after finishing the first viewing. This could indicate that two examples of the same procedure in each condition likely have given learners enough time to move onto the practice. Alternatively, it could also indicate a lack of effort for further comprehension of the material (van der Meij & Dunkel, 2020). As this was a controlled experiment, learners had no incentive in perfecting their skills more than they needed to complete the training.

Between the two mixed example conditions, although not significantly, for correct-incorrect examples condition there was a bigger proportion of unique playtime, total engagement time, and there were more replays. As videos may invite more passive processing (Salomon, 1984), this finding may indicate that the participants' attention in the correct-incorrect conditions may have been caught at the end of the video when the error

was shown in the second example. The error occurrence may have made them re-engage, stop and rewind parts of the video, thus ultimately spend more time engaging with the content. More research is required to understand how the video engagement alters when erroneous example being shown first or second.

To conclude, the presentation order of examples did not affect the time participants spent engaging with the videos. The high viewing rates show that the videos promoted sufficient engagement. Engagement measures used in this study, though, are only proxies showing time spent on the task. For more insight on engagement, measures such as eye tracking (see Van Gog, & Scheiter, 2010) could be used to gain insight into the allocation of visual attention which can ultimately help improve their design based on knowledge of how learners process certain materials.

6.2. Effects of presentation order of examples on self-efficacy

Self-efficacy is an individuals' confidence in their ability to achieve goals and produce outcomes (Bandura, 2010). It was expected and found that all three conditions would increase participants' self-efficacy. The results also revealed a large effect size. This finding is in line with other studies on self-efficacy development with example-based instructions (Hoogerheide et al., 2014; Huang, 2017; van Harsel et al., 2019). Besides, it supports the suggestion that observing another person successfully performing a task can increase the learner's belief in their ability to succeed in a similar task (Bandura, 1986).

The combination of mastery instruction and ensuing practice may explain why all condition examples were equally effective in self-efficacy development. According to Bandura's (1986) social cognitive theory, the most powerful source of self-efficacy is direct performance and the learner's interpretation of the performance. While vicarious experience on its own may have a weaker impact on self-efficacy, task performance, in this case, practice, can negate this impact (Schunk, 1989). As participants in all three conditions could immediately (re)produce the newly acquired skills they likely felt a sense of the success of their performance which could have contributed to their self-efficacy development.

Alternatively, although half of the participants indicated little prior knowledge with the domain, they were university students with presumably good software skills, therefore these existing software skills may have been transferable to the procedures shown in the video example. This could make the task appear less difficult even for beginners. Perceived difficulty of the task can influence the development of self-efficacy (Schunk, 1991), and students likely felt they could handle the material and made progress completing the tasks which could have contributed to the increase in self-efficacy.

In conclusion, the current study found virtually no difference between conditions for self-efficacy development. The study suggests that there is no reason to fear that erroneous examples harm participants' self-efficacy.

6.3. Effects of presentation order of examples on emotional reaction to error

The current study found that training yielded a shift in emotional reactions to errors from negative to neutral, and effect sizes pointed to a large difference. Results also revealed no differences between conditions.

One explanation for this result is that the present study avoided negative emotions stemming from self-made errors by investigating errors from other people and including error resolution (Tulis, Steuer, Dresel, 2015). Interestingly, the control group who saw correct only examples also indicated a shift in their emotional reactions to error towards more positive emotions. This shift in the control condition is likely to be because negative emotions in this group were simply not triggered from seeing only correct examples and potential self-made errors that may have occurred during practice tasks may have been infrequent enough to keep emotions at bay.

Second, contextual factors may have played a role in the emotional shift. Positive error climate where the error is an integrative part of the learning process was found to foster the development of more positive affective reaction to error (Oser & Spychier, 2005 in Tulis, Steuer, Dresel, 2015; Steuer et al., 2013). While the erroneous video examples did not include emotion control design elements (e.g. Keith & Frese, 2005), the narration was calm, friendly, and presented the error occurrence as a manageable situation, which could also have had an impact on how the errors were received.

Lastly, participants' subjective evaluation of the value of the task and its outcome could have also influenced the affective reaction (Pekrun, 2006). As the video training was a controlled experiment, all participants were rewarded regardless of their achievement and they may have not had an intense interest in the ultimate task outcome. Pekrun (2006) suggests that when learners care less about the task achievement and perceived value of the task is low, neither strongly positive nor strongly negative emotions are triggered. Future research might, therefore, want to investigate how the valence of emotional reactions develop when the intervention happens in a natural setting.

6.4. Effects of presentation order of examples on task performance

Because no pre-test was administered, it is not possible to tell how much participants already knew or learned, so the finding can only inform about the relative effectiveness of the three conditions. The presentation order of example did not affect task practice.

An average score of 96% was found which indicates that students in all conditions were willing to engage and successfully did so in the practice tasks. All three conditions equally yielded learning outcomes on the retention (89%) and transfer test (78%). These results may indicate that both mixed examples conditions were beneficial for general knowledge gain without overloading the learner's cognition. However, these results also mean that the main benefit of using erroneous examples, which is deeper learning engagement (Adams et

al., 2014) did not emerge as the mixed example conditions did not score better on retention and transfer tasks than correct example condition. The overall high-performance scores in all three conditions prevented learning effects of error to occur.

Between the two experimental conditions, the incorrect-correct condition consistently although not significantly, outperformed the correct-incorrect example condition. This slight difference in test outcomes for the two mixed examples conditions could indicate that incorrect-correct example condition managed to engage the learners from the start by showing erroneous examples first and subsequently more attention was paid to the corrective action as well as to the ensuing correct example. This appears to be in line with the suggestion from Kapur's productive failure (2012) that confronting learners with problem space before explicit instruction can increase performance as learners may be more attentive to correct solution when it becomes available for them. In combination with practice, incorrect-correct condition may have better reinforced procedural fluency (see Loibl et al., 2020). Alternatively, it is also possible that the design of sequencing of incorrect examples first may better reflect natural error occurrence as new software users are likely to run into errors first, and then correct it thus incorrect-correct example sequence may have made it easier to follow and learn from.

A specific advantage of mixed over correct only examples was found for error management. The two mixed example conditions equally and significantly developed participants' ability to diagnose and correct errors more so than did the correct only condition. In both cases, the effect size values pointed to a medium difference. This finding suggests that the mixed example design which includes error handling such as detection, diagnosis and correction (van der Meij & Gellevij, 2004) could foster error management skills (see Gartmeier, Bauer, Gruber & Heid, 2008; Klein et al., 2019; Tsovaltzi et al., 2012).

The overall task performance results were not correlated with prior knowledge, indicating that students of any level could benefit from the mixed examples which are similar to the finding of Barbieri and Booth (2016) and Heemsoth and Heinze (2014). It is also important to note, given the high overall scores, perhaps the procedures selected for this study were too easy to follow and learn from without incurring any excessive cognitive load. More research is needed to determine the effectiveness of mixed examples when it is used for more complex-multi step tasks. Additionally, a beneficial aspect of erroneous examples, namely its ability to enhance long term retention (see Adams et al., 2014; McLaren et al., 2015) was not tested in this study, therefore, it remains unclear whether presentation order of example influences the retention of procedural knowledge over time.

6.4.1. Relationship between emotional reaction to error and task performance

The results revealed that pre-training emotional reactions to errors were positively correlated to post-test error emotions in all three conditions. These data indicate that students with a more positive emotional stance towards error likely to respond with more

positive emotions after error experience, and a more negative stance towards errors likely to experience more negative emotions following error occurrence.

In the correct-incorrect experimental condition, a significant relationship between emotions towards errors after the video training and transfer test score was found. This link indicates that participants who reacted with more positive emotions to errors scored higher, while those who reacted with more negative emotions likely to have scored more poorly. As transfer tasks may be more challenging than retention tasks, learners with more positive emotions may invest more effort in dealing with the task and thus have better task performance. Research suggests that more positive emotions can foster academic performance (Pekrun, 2006; Pekrun et al., 2017) which is in line with this finding. Interestingly, however, all three conditions experienced changes in emotions towards the positive, but overall, it did not result in any significant relationship with participants' task performance.

While previous studies found evidence for a relationship between negative emotions and task performance (see Richey and al., 2019; Pekrun et al., 2017) link between positive emotions, or in this case more neutral tones, and performance is quite limited (see Pekrun et al., 2017; Pekrun, Elliot, & Maier, 2009). The lack of correlation in this study may indicate that neutral or more positive emotional reactions to errors may have more complex implications for performance. Pekrun, Eliott and Meier (2009) suggest that while positive emotions may support the learning processes, in terms of the strategy used and effort invested, they may also send a signal that everything is well and subsequent effort is not or less needed which can hinder performance. Alternatively, according to Melis (2004) observing someone else making an error may be less critical emotionally. Therefore, it may be that in a vicarious error experience the emotions towards errors are less intensified and subsequently may influence learning processes less than in the case of self-made errors.

Lastly, while the role of learner's belief about errors was not investigated in this study, it can also be a moderator of the relationship between emotions and learning outcome. Tulis, Steuer & Dresel (2017) found that believing that error is a learning opportunity can influence learners' emotional reaction to errors and their subsequent learning strategies and ultimately the learning outcome. Future research could consider investigating the role of belief about errors as a moderator in one's emotional reaction to errors, and subsequent learning outcome.

6.4.2. Effect of order of examples on error analytical skill & its relationship with task performance

The results revealed a significant increase in perceived error analytical skills equally in all three conditions following the video example. The effect sizes pointed to the existence of a large training effect. While the fact that participants on average perceived an improvement in their error analytical skill is a positive outcome, it is also an interesting finding.

Both mixed example conditions did expose participants to a detailed breakdown of error handling processes, and this additional benefit could have increased the quality and depth of error analytical processes (see Gartmeier, Bauer, Gruber & Heid, 2008) more than correct only examples could. However, the correct example condition also noted an increase in the participants' error analytical ability, which could probably be explained by the fact that participants may have run into errors while doing the practice tasks, and they may either chose to resolve these errors on their own or watch parts of the video that helped them get over the faulty steps. As direct contrast between error and correct solution is necessary for the development of error reflection and analytical skill (e.g. Durkin & Rittle -Johnson, 2012; ; Klein et al., 2019; Stark, Kopp, & Fischer; 2011), it may have been what facilitated the improvement of these skills or the perception of it.

Regarding the relationship between participants' perceived error analytical skill and their task performance, two significant findings came to light. First, in the incorrect-correct group, a positive link was found between learners' analytical skills and their error management test scores. This indicates that those who perceived their error reflection and analytical skills already good before the video training likely to have scored better on error diagnosis and correction tasks. Given, however, that this finding relates to how students' error analytical skills were before the video training took place, this finding may relate to their general cognitive ability to handling errors. Second, in the correct-incorrect condition, a positive relationship showed between the increase of error analytical skills and their higher retention test scores, which finding is in line with the suggestion that in-depth of analysis of an error may enhance understanding of the correct procedure and error avoidance thus ultimately lead to better task performance (Gartmeier, Bauer, Gruber & Heid, 2008)

Overall though, the randomness of these findings and the general lack of relationship between error analytical skills and the task performance suggest that there is a discrepancy between how participants perceived the development of their cognitive skills compared to how they performed. This discrepancy may reflect a general finding that the relationship between self-assessment of skills and actual knowledge tends to be weak to modest (Dunning, Heath & Suls, 2004). In short, it signals that people are not very successful in estimating their level of cognitive ability. They suggest that a one-off training session could potentially mislead self-assessment as speed and ease of learning does not equate being skilled or competent (see Stark & Kopp, 2020).

Alternatively, it may have been difficult to self-assess the development of one's cognitive activities gained from the video training without putting it to test. Although reasons for this finding can be manifold, to get a more accurate understanding of the development and the quality of error analysis skills, a better strategy may be to use "think aloud" verbal protocol data during task performance (see Keith & Frese, 2005) or recording of the screen.

6.5. Limitations & Future research

A potential shortcoming of the present study is the choice of incorporating both correct and incorrect examples in one video. The initial purpose was to try ensuring engagement with both examples. Splitting the current one video with two examples into two separate videos (see Krooshoop, 2019), may have provided better insight into the time spent on erroneous examples versus correct examples, and on the difference of the time spent on the incorrect examples between the two mixed example conditions.

Also, this work focused on the beginner level of Excel so more simple procedures with a varying number of steps and complexity. Therefore, having multiple examples combined with practice may have become redundant, thus decreased the mental effort participants had to put into the experiment. Future research may consider testing the effects of similar video examples using more complex multi-step procedures.

Finally, the error management test may have given an advantage to participants in mixed example conditions. As this experiment was not part of a school curriculum, participants who observed erroneous videos and those with higher prior knowledge could have had an advantage over participants of correct only example condition. It would be beneficial for future research to consider testing the impact of the intervention on error management skill in real classroom settings where prior knowledge is likely to be equal, and students are on the same learning track with the content. Besides, the error diagnostic & correction skills were measured by a multiple-choice test. While the use of a multiple-choice test has the advantage of minimizing cognitive load and guiding learner's choices, it also has the disadvantage of enabling students to game the questionnaire (Adams et al., 2014). To improve the assessment of the development of error management skills future research may want to use methods such as open-ended questions or recording of screens.

6.6. Theoretical implications & Practical implications

The present study investigated the effects of presentation order of examples on learning a procedure. Although the mix of correct and incorrect examples are increasingly researched, the knowledge about how erroneous example design can be the most beneficial for learning still needs more attention. This research is the first exploration of the effect of the varying sequence of correct and incorrect examples in video instructions that teaches software procedure, therefore, a worthy addition to existing literature.

Moreover, only a few prior researches paid attention to the effect of examples on underlying processes such as self-efficacy. While here the example design did not specifically target self-efficacy, this study contributes to the literature confirming that using mixed examples in the instruction are not any less beneficial at fostering self-efficacy than correct examples.

Lastly, previous studies did not investigate how example-based instruction, whether it be a correct or incorrect example, affect emotions. Therefore, this research can be viewed

as an exploration into a new research area into a broader topic of the relationship between example-based instruction and emotions.

From a practical perspective, students and employees of today have to possess software skills (OECD, 2017). Error inclusive software instructions and training, however, are still scarce in technical communication (Van der Meij, Karreman, & Steehouder, 2009) . The outcome of this study suggests that there is a potential in incorporating a mix of correct and incorrect procedures to effectively teach software skills, especially when error management information is given. This way one may not only learn correct procedures but also develop reflection and analytical skills for future troubleshooting.

6.7. Conclusion

To conclude, this study found in the correct-incorrect example group a significant relationship between the decrease of negative emotions towards error and the increase of transfer test score. Additionally, in the correct-incorrect condition, a significant link appeared between participants increase of error analytical skills and their higher retention test scores. Despite these findings, all other investigated variables were unaffected by the presentation order of examples. Participants in all three conditions held increased self-efficacy beliefs after training. Furthermore, mixed example conditions appeared not to trigger negative emotions. Task performance results imply that both mixed examples conditions were significantly more effective in developing error management skills than correct examples, however, in regular task performance, all three conditions were equally effective. This research can be viewed as the first exploration of the effects of the presentation order of examples. Since erroneous examples hold a lot of potential benefits for learners, it is important to continue exploring what aspects of example-design can positively impact learning processes.

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APPENDIX A - Instructional booklet including pre-and post-test questionnaires and performance tests

TIPS & TRICKS OF USING EXCEL FOR DATA PREPARATION

INSTRUCTIONAL BOOKLET

Thank you for agreeing to participate in this research experiment. During the experiment I would require your complete, undistracted attention. So, I ask that you follow these instructions carefully. Please do not open other applications on your computer or engage in other distracting activities (e.g. using phone).

You are asked to follow all instructions of this booklet. The instructor will be in the room throughout the entire session but can only be consulted if you feel discomfort and wish to withdraw from the experiment.

First, please fill out the below questions about you. All information will be handled confidentially by the researcher.

Name:

Age:

Gender:

Study programme:

Information about the current research

Purpose of The Study

This research is being conducted as part of my MSc thesis. I am inviting you to participate in this research project about studying the effects of errors on knowledge gain in instructional videos.

Procedures

You will participate in an experiment lasting approximately 50-60 min. After signing the consent, form, you will receive a prior knowledge and self-efficacy questionnaire. After that you will be instructed to watch four videos, each lasting between 4-6 minutes. Each video presents two examples for the use of an Excel feature. In the videos it is possible that you will see common errors made or found when using Excel software. This example can be presented in either Example 1 or Example 2, therefore you are encouraged to watch the videos from beginning to end. After each video you will be asked to do a short practice activity. The purpose to perform what you observed in the video. At the end of the tutorial, you will have to fill in two questionnaires. After that you will also be asked to perform some tasks similar to what was shown in the videos and fill out a short multiple choice question.

Potential Risks and Discomforts

There are no obvious physical, legal or economic risks associated with participating in this study. You do not have to answer any questions you do not wish to.

Potential Benefits

Participation in this study does guarantee some beneficial results to you. As a result of participating you may better understand how to do basic data preparation and analysis is Excel.

Confidentiality

Your privacy will be protected to the maximum extent allowable by law. Your confidential information or personal data is not disclosed in any way. Before the research data is released, your data will be made anonymous. In addition, this research has been assessed and approved by the ethics committee of the BMS faculty. After the experiment, everything will be anonymized, and the data will no longer be traceable to a specific person.

Right to Withdraw and Questions

Your participation in this research is completely voluntary. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify. The data you provided before you stopped participating however will be processed in this research; no new data will be collected or used.

If you have questions, concerns, please contact the primary researcher:

Hajnalka Dancsi, h.dancsi@student.utwente.nl, MSc Student, Education Science & Technology

Statement of Consent

Your signature indicates that you have read this consent form or have had it read to you; your questions have been answered to your satisfaction.

1. I agree to voluntarily participate in a research project led by Hajnalka Dancsi. The purpose of this document is to specify the terms of my participation in this research project.

2. I have been given enough information about this research project. The purpose of my participation as a participant in this project has been explained to me and is clear.

3. My participation in this project is voluntary. There is no explicit or implicit coercion whatsoever to participate. It is clear to me that in case I do not want to continue with my participation at any point of time I am fully entitled to withdraw.

4. Participation involves filling in questionnaires, watching videos, practicing between the videos and completing a knowledge test. The experiment will last approximately 50-60 minutes. I allow the researcher to use my data gathered for her study.

5. I have been given the guarantee that this research project has been reviewed and approved by the BMS Ethics Committee. For research problems or any other question regarding the research project, the Secretary of the Ethics Commission of the faculty Behavioural, Management and Social Sciences at University Twente may be contacted through ethicscommittee-bms@utwente.nl

6. I have read and understood the points and statements of this form. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

_____	_____	_____
Participant name [printed]	Signature	Date

_____	_____	_____
Researcher name [printed]	Signature	Date

PART I

Please read the below explanation about the project. Here you do not do any activities yet.

In this session you will learn to work with some of the feature of Excel program that you can use for preparing data for statistical programs. So, in the videos, you will hear references to SPSS or R.

The session consists of instructional videos, practice and an assessment before and after watching videos.

This manual tells you exactly **what to do**.
There are three tasks. The images in front of it help you with this.

Watch video

If you see this picture you will ***watch a video.***
You will see which video needs to be open.
There are two examples presented in each video. One of the examples is likely to include common *errors made using Excel*. To learn about the error, you are strongly advised to watch each video entirely.

Do Practice

If you see this picture, you will do ***practice*** the feature you saw in the video.
It will be stated what task you need to perform and which Excel file you need to open, and which Sheet of the Excel file you need to work in (e.g. Sheet1)

Do Assessment

When you see this picture, you will fill out an ***assessment*** form(s).
It will be stated whether you have to complete a questionnaire, a knowledge test or both.

PART II.

Please fill out the below questionnaire, selecting the responses that best describe your current situation.

	Weak									**Excellent**
1. Please rate your experience in working with Excel:	1	2	3	4	5	6	7	8	9	10

In Excel, how well can you:	**Weak**						**Excellent**
2. Set up a dataset	1	2	3	4	5	6	7
3. Insert data	1	2	3	4	5	6	7
4. Replace all identical numbers in a column	1	2	3	4	5	6	7
5. Use Filters	1	2	3	4	5	6	7
6. Split content of a column into multiple columns	1	2	3	4	5	6	7
7. Use formulas	1	2	3	4	5	6	7

	Weak									**Excellent**
8. Please rate your experience in error handling with Excel	1	2	3	4	5	6	7	8	9	10

In Excel, when an error occurs:	**Strongly disagree**						**Strongly agree**
9. I consider it as a great learning opportunity	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. I analyse the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. I think about possible causes	**1**	**2**	**3**	**4**	**5**	**6**	**7**

12. I try to solve the error in any way I can	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. I ask Excel for help	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. I try to think back at what I did	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. I feel upset	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. I feel annoyed	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. I quickly lose concentration	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. I stay calm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19. I feel sad	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. My mood drops	**1**	**2**	**3**	**4**	**5**	**6**	**7**

PART III.

Now it's time for the training.
To access the videos, type the following link name in Firefox browser: https://graasp.eu/s/qvkh5k
Login to the website using your full name.
Here you find all four videos you will watch during this session (e.g. Video 1, Video 2)

You will also need to access the Practice document so you can exercise after watching the videos.
From the pendrive you received from the research assistant, open the file named "Practice".
Do **not** work in the document yet.

If there is a problem with opening the file or the videos, please signal it to the research assistant.

Now, please read carefully and follow the instructions.

I. **Please review the pre-training document to familiarize yourself with the basics of Excel. You can find a copy of it on your desk.**

II. **When you are ready, proceed with the next steps outlined on the next page.**

Watch Video 1. Splitting data values over columns

Go to the website where you have logged in and watch Video 1 until you know how this feature works in Excel.
You will see two examples in the video. Watch both Example 1 and Example 2.
To see the video in full screen size, right click in the video and select "full size".
You can pause and rewind if you feel it is necessary.
Now do not read any further and start with the video 1.

Practice 1. Splitting up the content of one column many columns

To complete the practice for Video 1, follow the below steps. Do not spend more than app. 2-3 minutes on the practice.

1. Open the Practice Excel file you have already sourced from the pen drive
2. Go to the Sheet1
3. Use Text to Columns feature to split up the data content of column A into multiple columns.
4. Save your work as" Practice_ your full name" on the pen drive you received.

<u>You will use this one document for all Practices task from now.</u>
Keep your version and close the original file now.
When you are ready with practice, move onto the next step.

Watch Video 2. Displaying selected data values only

Watch Video 2 until you know how this feature works in Excel.
You will see two examples in the video. Watch both Example 1 and Example 2.
You can pause and rewind if you feel it is necessary.
Now do not read any further and open the video.

Practice 2. **Displaying only the result of female employees of Stoner's Pot Palace company**

To complete the practice for Video 2, follow the below steps. Do not spend more than app. 2 -3 minutes on the practice.

1. Go back to your version of Practice file
2. Go to Sheet2
3. Add filters to your dataset
4. Filter on company column to see "Stoner's Pot Palace" only
5. Also Filter on gender to only see women (F as female in the dataset)
6. Save your current work

When you are ready with practice, move onto the next step.

Watch Video 3. Modifying multiple data values

Watch Video 3 until you know how this feature works in Excel.
You will see two examples in the video. Watch both Example 1 and Example 2.
You can pause and rewind if you feel it is necessary.
Now do not read any further and open the video.

Practice 3. Modify the city of data collection to numbers

To complete the practice for Video 3, please follow the below steps. Do not spend more than app. 2 min on the practice.

1. Go back to your version of Practice file.
2. Go to Sheet3
3. In column B, change the city name “Springfield” to 1, and “Shelbyville” to 2.
4. Save your current work

When you are ready with practice, move onto the next step.

Watch Video 4. Changing text values to capital or lowercase

Watch Video 4 until you know how this feature works in Excel.
You will see two examples in the video. Watch both Example 1 and Example 2.
You can pause and rewind if you feel it is necessary.
Now do not read any further and open the video.

Practice 4. Changing languages to lowercase

To complete the practice, please follow the below steps. Do not spend more than app. 2 min on the practice.

1. Go back to your version of Practice file.
2. Go to Sheet3
3. in column F, Transform the company names to lower letter case
4. Save your current work

When you are finished with Practice 4, if you have not done it yet, save your current Practice document to the pen drive (“Practice_your full name”). Only **one** version of **your** practice document should be on the pen drive.
Once the document is **saved**, **close it** as you do not need it anymore.
Now, move onto the next page.

PART IV

This is now time for assessment. **You are <u>not</u> allowed to watch the videos anymore,** so please **<u>close the website with the videos.</u>**

You will have 30 minutes to complete the questionnaire and the test tasks.

You are asked to mark the time of the beginning of the knowledge test and the end of it.

Start time of the assessment: _____

I. Please fill out the below questionnaire, selecting the responses that best describe your current situation.

	Weak									**Excellent**
1. Please rate your experience in working with Excel:	1	2	3	4	5	6	7	8	9	10

In Excel, how well can you:	**Weak**						**Excellent**
2. Set up a dataset	1	2	3	4	5	6	7
3. Insert data	1	2	3	4	5	6	7
4. Replace all identical numbers in a column	1	2	3	4	5	6	7
5. Use Filters	1	2	3	4	5	6	7
6. Split content of a column into multiple columns	1	2	3	4	5	6	7
7. Use formulas	1	2	3	4	5	6	7

	Weak									**Excellent**
8. Please rate your experience in error handling with Excel	1	2	3	4	5	6	7	8	9	10

In Excel, when an error occurs:	**Strongly disagree**	**Strongly agree**

9. I consider it as a great learning opportunity	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. I analyse the problem	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. I think about possible causes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. I try to solve the error in any way I can	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. I ask Excel for help	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. I try to think back at what I did	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. I feel upset	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. I feel annoyed	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. I quickly lose concentration	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. I stay calm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19. I feel sad	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. My mood drops	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Please now move onto to the next page.

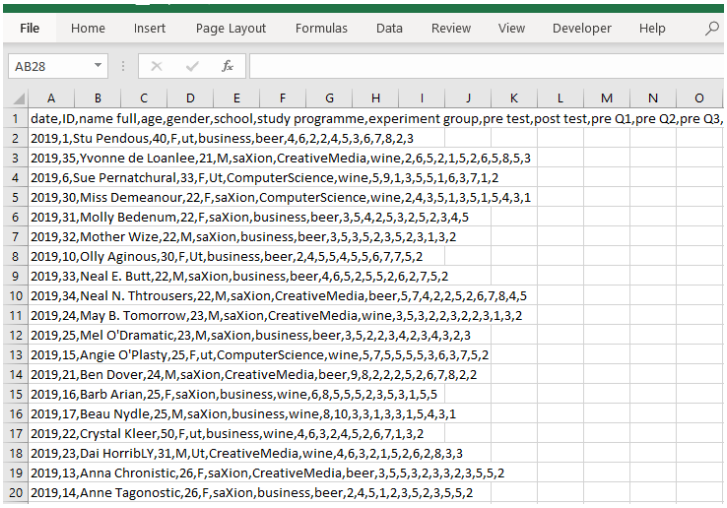
II. **Now, you will do tasks similar what you saw in the videos.**

From the pen drive, Open the Excel document named “Test”.
You will use this **one** document for all the task in the assessment, so save the document as “Test_your full name” on the pendrive. Keep this file open and close the original one.

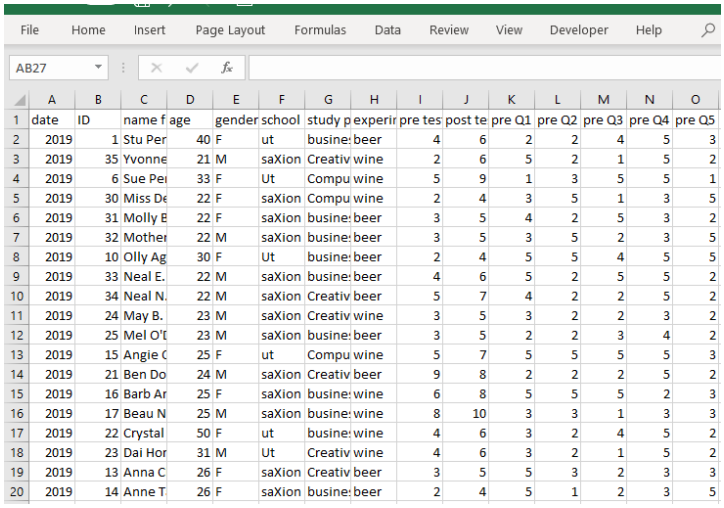
Within your Test document you will switch between Sheet1, Sheet2, Sheet3 and Sheet4 like what you did during practice.

1. **Go to Sheet1 in your version of the Test document. You will use the dataset in this sheet to complete the task for Q1.**

Q1. Make this dataset usable for analysis by splitting it up to columns. For expected result of the task, see below the before and after image example. When you are finished, save your work in your current document.



	A
1	date,ID,name full,age,gender,school,study programme,experiment group,pre test,post test,pre Q1,pre Q2,pre Q3,
2	2019,1,Stu Pendous,40,F,ut,business,beer,4,6,2,2,4,5,3,6,7,8,2,3
3	2019,35,Yvonne de Loanlee,21,M,saXion,CreativeMedia,wine,2,6,5,2,1,5,2,6,5,8,5,3
4	2019,6,Sue Pernatchural,33,F,Ut,ComputerScience,wine,5,9,1,3,5,5,1,6,3,7,1,2
5	2019,30,Miss Demeanour,22,F,saXion,ComputerScience,wine,2,4,3,5,1,3,5,1,5,4,3,1
6	2019,31,Molly Bedenum,22,F,saXion,business,beer,3,5,4,2,5,3,2,5,2,3,4,5
7	2019,32,Mother Wize,22,M,saXion,business,beer,3,5,3,5,2,3,5,2,3,1,3,2
8	2019,10,Olly Aginous,30,F,Ut,business,beer,2,4,5,5,4,5,5,6,7,7,5,2
9	2019,33,Neal E. Butt,22,M,saXion,business,beer,4,6,5,2,5,5,2,6,2,7,5,2
10	2019,34,Neal N. Thtrousers,22,M,saXion,CreativeMedia,beer,5,7,4,2,2,5,2,6,7,8,4,5
11	2019,24,May B. Tomorrow,23,M,saXion,CreativeMedia,wine,3,5,3,2,2,3,2,2,3,1,3,2
12	2019,25,Mel O'Dramatic,23,M,saXion,business,beer,3,5,2,2,3,4,2,3,4,3,2,3
13	2019,15,Angie O'Plasty,25,F,ut,ComputerScience,wine,5,7,5,5,5,5,3,6,3,7,5,2
14	2019,21,Ben Dover,24,M,saXion,CreativeMedia,beer,9,8,2,2,2,5,2,6,7,8,2,2
15	2019,16,Barb Arian,25,F,saXion,business,wine,6,8,5,5,5,2,3,5,3,1,5,5
16	2019,17,Beau Nydle,25,M,saXion,business,wine,8,10,3,3,1,3,3,1,5,4,3,1
17	2019,22,Crystal Kleer,50,F,ut,business,wine,4,6,3,2,4,5,2,6,7,1,3,2
18	2019,23,Dai HorribLY,31,M,Ut,CreativeMedia,wine,4,6,3,2,1,5,2,6,2,8,3,3
19	2019,13,Anna Chronistic,26,F,saXion,CreativeMedia,beer,3,5,5,3,2,3,3,2,3,5,5,2
20	2019,14,Anne Tagonostic,26,F,saXion,business,beer,2,4,5,1,2,3,5,2,3,5,5,2

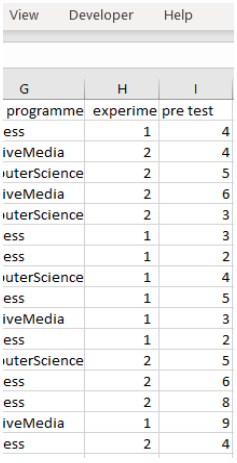


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	date	ID	name f	age	gender	school	study p	experir	pre tes	post te	pre Q1	pre Q2	pre Q3	pre Q4	pre Q5
2	2019	1	Stu Per	40	F	ut	busine	beer	4	6	2	2	4	5	3
3	2019	35	Yvonne	21	M	saXion	Creativ	wine	2	6	5	2	1	5	2
4	2019	6	Sue Per	33	F	Ut	Compu	wine	5	9	1	3	5	5	1
5	2019	30	Miss De	22	F	saXion	Compu	wine	2	4	3	5	1	3	5
6	2019	31	Molly B	22	F	saXion	busine	beer	3	5	4	2	5	3	2
7	2019	32	Mother	22	M	saXion	busine	beer	3	5	3	5	2	3	5
8	2019	10	Olly Ag	30	F	Ut	busine	beer	2	4	5	5	4	5	5
9	2019	33	Neal E.	22	M	saXion	busine	beer	4	6	5	2	5	5	2
10	2019	34	Neal N.	22	M	saXion	Creativ	beer	5	7	4	2	2	5	2
11	2019	24	May B.	23	M	saXion	Creativ	wine	3	5	3	2	2	3	2
12	2019	25	Mel O't	23	M	saXion	busine	beer	3	5	2	2	3	4	2
13	2019	15	Angie (	25	F	ut	Compu	wine	5	7	5	5	5	5	3
14	2019	21	Ben Do	24	M	saXion	Creativ	beer	9	8	2	2	2	5	2
15	2019	16	Barb Ar	25	F	saXion	busine	wine	6	8	5	5	5	2	3
16	2019	17	Beau N	25	M	saXion	busine	wine	8	10	3	3	1	3	3
17	2019	22	Crystal	50	F	ut	busine	wine	4	6	3	2	4	5	2
18	2019	23	Dai Hor	31	M	Ut	Creativ	wine	4	6	3	2	1	5	2
19	2019	13	Anna C	26	F	saXion	Creativ	beer	3	5	5	3	2	3	3
20	2019	14	Anne T	26	F	saXion	busine	beer	2	4	5	1	2	3	5

2. **Now, go to Sheet2 in your version of the Test document. You will use the dataset in this sheet to complete the task for Q2-Q4.**

Q2. In column H, Change the names from text to number. Change “beer” to 1, and “wine” to 2. For expected result of the task, see below the before and after image example. When you are finished, save your work in the current document.

G	H	I
ły programme	experime	pre test
iness	beer	4
ativeMedia	wine	4
nputerScience	wine	5
ativeMedia	wine	6
nputerScience	wine	3
iness	beer	3
iness	beer	2
nputerScience	beer	4
iness	beer	5
ativeMedia	beer	3
iness	beer	2
nputerScience	wine	5
iness	wine	6
iness	wine	8
ativeMedia	beer	9
iness	wine	4



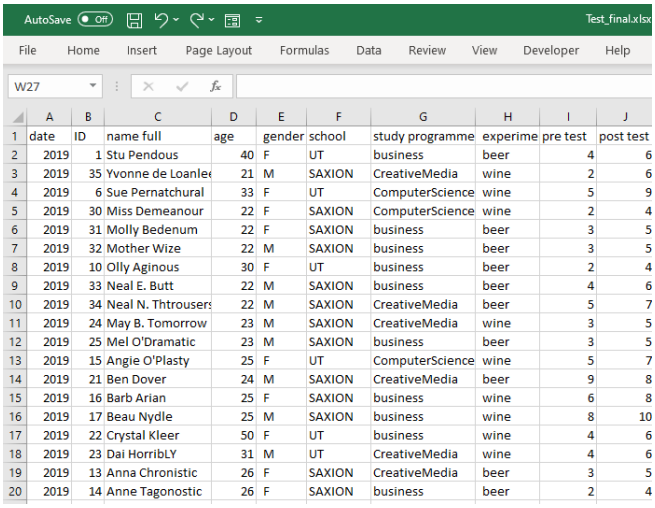
G	H	I
programme	experime	pre test
ess	1	4
iveMedia	2	4
uterScience	2	5
iveMedia	2	6
uterScience	2	3
ess	1	3
ess	1	2
uterScience	1	4
ess	1	5
iveMedia	1	3
ess	1	2
uterScience	2	5
ess	2	6
ess	2	8
iveMedia	1	9
ess	2	4

Q3. You continue to work in Sheet2. In column F, transform the university names to capital letter case. For expected result of the task, see below the before and after image example. When you are finished, save your work in your current document.

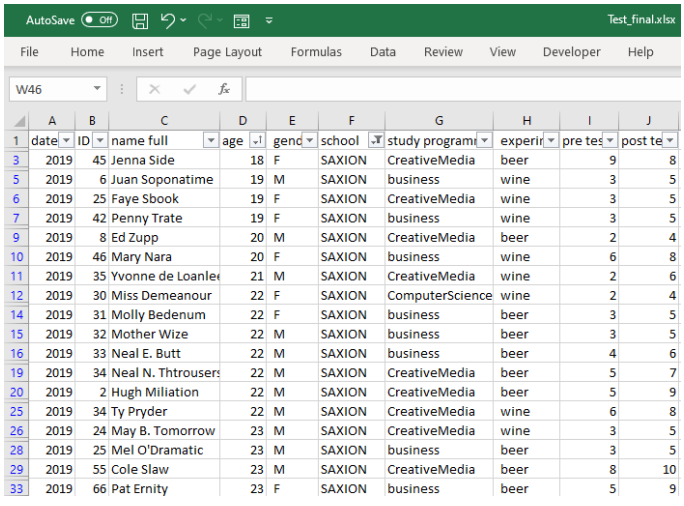
E	F	
nder	school	stud
	ut	busi
	saXion	Crea
	Ut	Com
	saXion	Com
	saXion	busi
	saXion	busi
	Ut	busi
	saXion	busi
	saXion	Crea
	saXion	Crea
	saXion	busi
	ut	Com
	saXion	Crea
	saXion	busi

E	F	
nder	school	study
	UT	busir
	SAXION	Creat
	UT	Comp
	SAXION	Comp
	SAXION	busir
	SAXION	busir
	UT	busir
	SAXION	busir
	SAXION	Creat
	SAXION	Creat
	SAXION	busir
	UT	Comp
	SAXION	Creat
	SAXION	busir

Q4. You are still in Sheet2. Display data only for students of Saxion university from youngest to oldest students. For expected result of the task, see the image below. When you are finished, save your work in your current document.



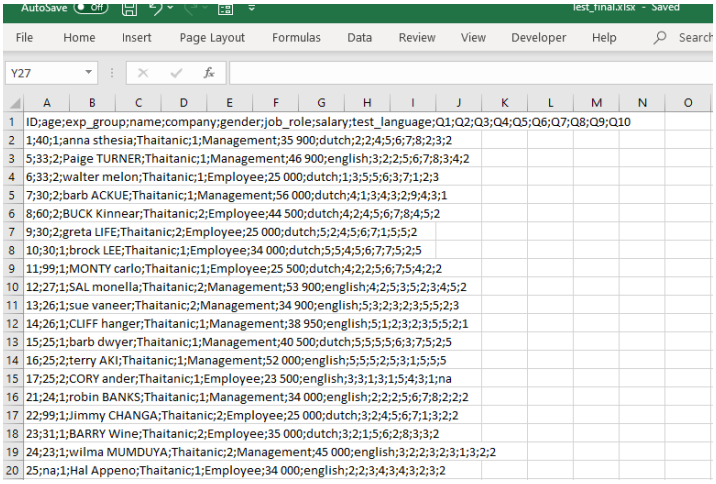
	A	B	C	D	E	F	G	H	I	J
1	date	ID	name full	age	gender	school	study programme	experime	pre test	post test
2	2019	1	Stu Pendous	40	F	UT	business	beer	4	6
3	2019	35	Yvonne de Loanlee	21	M	SAXION	CreativeMedia	wine	2	6
4	2019	6	Sue Pernatchural	33	F	UT	ComputerScience	wine	5	9
5	2019	30	Miss Demeanour	22	F	SAXION	ComputerScience	wine	2	4
6	2019	31	Molly Bedenum	22	F	SAXION	business	beer	3	5
7	2019	32	Mother Wize	22	M	SAXION	business	beer	3	5
8	2019	10	Olly Aginous	30	F	UT	business	beer	2	4
9	2019	33	Neal E. Butt	22	M	SAXION	business	beer	4	6
10	2019	34	Neal N. Thtrousers	22	M	SAXION	CreativeMedia	beer	5	7
11	2019	24	May B. Tomorrow	23	M	SAXION	CreativeMedia	wine	3	5
12	2019	25	Mel O'Dramatic	23	M	SAXION	business	beer	3	5
13	2019	15	Angie O'Plasty	25	F	UT	ComputerScience	wine	5	7
14	2019	21	Ben Dover	24	M	SAXION	CreativeMedia	beer	9	8
15	2019	16	Barb Arian	25	F	SAXION	business	wine	6	8
16	2019	17	Beau Nydle	25	M	SAXION	business	wine	8	10
17	2019	22	Crystal Kleer	50	F	UT	business	wine	4	6
18	2019	23	Dai HorribLY	31	M	UT	CreativeMedia	wine	4	6
19	2019	13	Anna Chronistic	26	F	SAXION	CreativeMedia	beer	3	5
20	2019	14	Anne Tagonostic	26	F	SAXION	business	beer	2	4



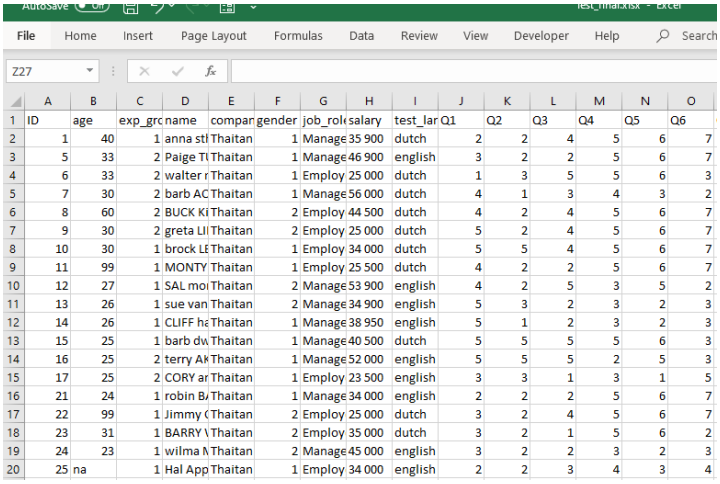
	A	B	C	D	E	F	G	H	I	J
1	date	ID	name full	age	gend	school	study program	experi	pre tes	post te
3	2019	45	Jenna Side	18	F	SAXION	CreativeMedia	beer	9	8
5	2019	6	Juan Soponatime	19	M	SAXION	business	wine	3	5
6	2019	25	Faye Sbook	19	F	SAXION	CreativeMedia	wine	3	5
7	2019	42	Penny Trate	19	F	SAXION	business	wine	3	5
9	2019	8	Ed Zupp	20	M	SAXION	CreativeMedia	beer	2	4
10	2019	46	Mary Nara	20	F	SAXION	business	wine	6	8
11	2019	35	Yvonne de Loanlee	21	M	SAXION	CreativeMedia	wine	2	6
12	2019	30	Miss Demeanour	22	F	SAXION	ComputerScience	wine	2	4
14	2019	31	Molly Bedenum	22	F	SAXION	business	beer	3	5
15	2019	32	Mother Wize	22	M	SAXION	business	beer	3	5
16	2019	33	Neal E. Butt	22	M	SAXION	business	beer	4	6
19	2019	34	Neal N. Thtrousers	22	M	SAXION	CreativeMedia	beer	5	7
20	2019	2	Hugh Miliation	22	M	SAXION	CreativeMedia	beer	5	9
25	2019	34	Ty Pryder	22	M	SAXION	CreativeMedia	wine	6	8
26	2019	24	May B. Tomorrow	23	M	SAXION	CreativeMedia	wine	3	5
28	2019	25	Mel O'Dramatic	23	M	SAXION	business	beer	3	5
29	2019	55	Cole Slaw	23	M	SAXION	CreativeMedia	beer	8	10
33	2019	66	Pat Ernity	23	F	SAXION	business	beer	5	9

3. **Go to Sheet3 in your version of the Test document. You will use the dataset in this sheet to complete the task for Q5**

Q5. Split up the dataset into columns. For expected result of the task, see below the before and after image example. When you are finished, save your work in your current document.



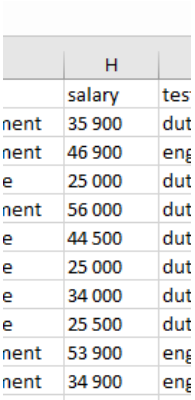
	A
1	ID;age;exp_group;name;company;gender;job_role;salary;test_language;Q1;Q2;Q3;Q4;Q5;Q6;Q7;Q8;Q9;Q10
2	1;40;1;anna sthesia;Thaitanic;1;Management;35 900;dutch;2;2;4;5;6;7;8;2;3;2
3	5;33;2;Paige TURNER;Thaitanic;1;Management;46 900;english;3;2;2;5;6;7;8;3;4;2
4	6;33;2;walter melon;Thaitanic;1;Employee;25 000;dutch;1;3;5;5;6;3;7;1;2;3
5	7;30;2;barb ACKUE;Thaitanic;1;Management;56 000;dutch;4;1;3;4;3;2;9;4;3;1
6	8;60;2;BUCK Kinnear;Thaitanic;2;Employee;44 500;dutch;4;2;4;5;6;7;8;4;5;2
7	9;30;2;greta LIFE;Thaitanic;2;Employee;25 000;dutch;5;2;4;5;6;7;1;5;5;2
8	10;30;1;brock LEE;Thaitanic;1;Employee;34 000;dutch;5;5;4;5;6;7;7;5;2;5
9	11;99;1;MONTY carlo;Thaitanic;1;Employee;25 500;dutch;4;2;2;5;6;7;5;4;2;2
10	12;27;1;SAL monella;Thaitanic;2;Management;53 900;english;4;2;5;3;5;2;3;4;5;2
11	13;26;1;sue vaneer;Thaitanic;2;Management;34 900;english;5;3;2;3;2;3;5;5;2;3
12	14;26;1;CLIFF hanger;Thaitanic;1;Management;38 950;english;5;1;2;3;2;3;5;5;2;1
13	15;25;1;barb dwyer;Thaitanic;1;Management;40 500;dutch;5;5;5;5;6;3;7;5;2;5
14	16;25;2;terry AKI;Thaitanic;1;Management;52 000;english;5;5;5;2;5;3;1;5;5;5
15	17;25;2;CORY ander;Thaitanic;1;Employee;23 500;english;3;3;1;3;1;5;4;3;1;na
16	21;24;1;robin BANKS;Thaitanic;1;Management;34 000;english;2;2;2;5;6;7;8;2;2;2
17	22;99;1;Jimmy CHANGA;Thaitanic;2;Employee;25 000;dutch;3;2;4;5;6;7;1;3;2;2
18	23;31;1;BARRY Wine;Thaitanic;2;Employee;35 000;dutch;3;2;1;5;6;2;8;3;3;2
19	24;23;1;wilma MUMDUYA;Thaitanic;2;Management;45 000;english;3;2;2;3;2;3;1;3;2;2
20	25;na;1;Hal Appeno;Thaitanic;1;Employee;34 000;english;2;2;3;4;3;4;3;2;3;2



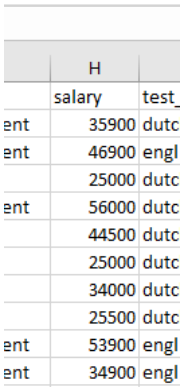
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	ID	age	exp_gr	name	compar	gender	job_rol	salary	test_lar	Q1	Q2	Q3	Q4	Q5	Q6
2	1	40	1	anna stl	Thaitan	1	Manage	35 900	dutch	2	2	4	5	6	7
3	5	33	2	Paige TI	Thaitan	1	Manage	46 900	english	3	2	2	5	6	7
4	6	33	2	walter r	Thaitan	1	Employ	25 000	dutch	1	3	5	5	6	3
5	7	30	2	barb AC	Thaitan	1	Manage	56 000	dutch	4	1	3	4	3	2
6	8	60	2	BUCK Ki	Thaitan	2	Employ	44 500	dutch	4	2	4	5	6	7
7	9	30	2	greta LI	Thaitan	2	Employ	25 000	dutch	5	2	4	5	6	7
8	10	30	1	brock LE	Thaitan	1	Employ	34 000	dutch	5	5	4	5	6	7
9	11	99	1	MONTY	Thaitan	1	Employ	25 500	dutch	4	2	2	5	6	7
10	12	27	1	SAL moi	Thaitan	2	Manage	53 900	english	4	2	5	3	5	2
11	13	26	1	sue van	Thaitan	2	Manage	34 900	english	5	3	2	3	2	3
12	14	26	1	CLIFF ha	Thaitan	1	Manage	38 950	english	5	1	2	3	2	3
13	15	25	1	barb dw	Thaitan	1	Manage	40 500	dutch	5	5	5	5	6	3
14	16	25	2	terry AK	Thaitan	1	Manage	52 000	english	5	5	5	2	5	3
15	17	25	2	CORY ar	Thaitan	1	Employ	23 500	english	3	3	1	3	1	5
16	21	24	1	robin BA	Thaitan	1	Manage	34 000	english	2	2	2	5	6	7
17	22	99	1	Jimmy C	Thaitan	2	Employ	25 000	dutch	3	2	4	5	6	7
18	23	31	1	BARRY \	Thaitan	2	Employ	35 000	dutch	3	2	1	5	6	2
19	24	23	1	wilma M	Thaitan	2	Manage	45 000	english	3	2	2	3	2	3
20	25	na	1	Hal App	Thaitan	1	Employ	34 000	english	2	2	3	4	3	4

4. **Go to Sheet4 in your Test document. You will use the dataset in this sheet to complete the task for Q6-Q7.**

Q6. In column H, the numbers look like numeric values, but Excel considers them text. Change the current text values into numeric values. For expected result of the task, see below the before and after image example. When you are finished, save your work in your current document.



	H	
	salary	tes
nent	35 900	dut
nent	46 900	eng
e	25 000	dut
nent	56 000	dut
e	44 500	dut
e	25 000	dut
e	34 000	dut
e	25 500	dut
nent	53 900	eng
nent	34 900	eng



	H	
	salary	test_
ent	35900	dutc
ent	46900	engl
	25000	dutc
ent	56000	dutc
	44500	dutc
	25000	dutc
	34000	dutc
	25500	dutc
ent	53900	engl
ent	34900	engl

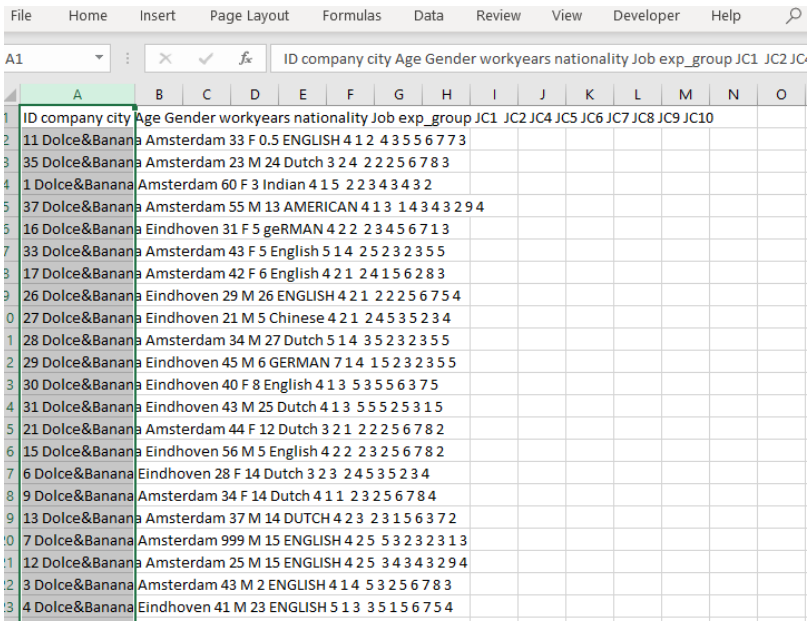
Q7. In column D, Make the name of the participants start with capital letters by using the formula named “PROPER”. The expected result of the task sees below the before and after image example. When you are finished, save your current document.

C	D	
group	name	comp
1	anna sthesia	Thait
2	Paige TURNER	Thait
2	walter melon	Thait
2	barb ACKUE	Thait
2	BUCK Kinnear	Thait
2	greta LIFE	Thait
1	brock LEE	Thait
1	MONTY carlo	Thait
1	SAL monella	Thait
1	sue vaneer	Thait
1	CLIFF hanger	Thait
1	barb dwyer	Thait
2	terry AKI	Thait
2	CORY ander	Thait
1	robin BANKS	Thait

C	D	
group	name	comp
1	Anna Sthesia	Thait
2	Paige Turner	Thait
2	Walter Melon	Thait
2	Barb Ackue	Thait
2	Buck Kinnear	Thait
2	Greta Life	Thait
1	Brock Lee	Thait
1	Monty Carlo	Thait
1	Sal Monella	Thait
1	Sue Vaneer	Thait
1	Cliff Hanger	Thait
1	Barb Dwyer	Thait
2	Terry Aki	Thait
2	Cory Ander	Thait
1	Robin Banks	Thait

III. Answer each of the following multiple-choice question by marking the letter that corresponds to the correct response.

Q8a. Look at the below image. I have tried to split up the content of column A however the content remained unseparated, in the same column. What might have gone wrong?



a) I did not make enough space for this content to be split up
b) I selected the incorrect character when trying to make the data usable
c) I did not correctly select the column to be split
d) None of the above describes the error

Q8b. What would you do different?

a) I would select the exact column that I want to split
b) I would add an extra column next to this dataset
c) I would select the appropriate character for splitting the data values
d) None of the above would resolve the issue

Q9. On the picture you see that F letters were replaced by 2 everywhere. Why did this error happen?

C	D	E	F
2ull name	gender	age	country
Stu Pendous	2	40	2rance
2red Preem	2	33	2rance
Sue Pernatchural	2	33	USA
2rida Arious	M	30	USA
Wendy 2rankenstei	2	30	2innland
2amke B. Sorry	2	30	2rance
Olly Aginous	2	30	Germany
ble N. Dwilling	2	27	Germany
Amber Alert	2	27	2rance
2enna Chronistic	2	26	2innland
Anne Tagonostic	2	26	USA
Angie O'Plasty	2	25	2rance
Barb Arian	2	25	2rank2urt
Beau Nydle	M	25	Munster
Ben Dover	M	24	2rank2urt
Crystal Kleer	2	50	2rank2urt

a) Wrong data format was selected to be changed
b) The selection for modifying values was incorrectly indicated
c) A typo error was made in the replace window
d) None of the above describes the error

Q10a. On the image below you see an error in transforming text values to Uppercase. What does this error message mean?

F	G	H
workyea		Job
1	#REF!	4
24	#REF!	3
3	#REF!	4
13	#REF!	4
5	#REF!	4
5	#REF!	5
6	#REF!	4
26	#REF!	4

a) the formula name is incorrect
b) the equal sign is missing
c) the cell source in the formula was deleted
d) None of the above describes the error

Q10b. What would you do to correct this error?

a) Would insert a + sign to properly start the formula
b) I would transform the formula to text
c) I would use the correct formula name
d) None of the above describes the solution to this error

This is the end of this experiment.
Please mark here the time you finish the assessment: _____

Make sure both Practice and Test files are **already** saved on the pen drive. File naming should end with your full name e.g. “Test_Smith”.

Thank you for your participation 😊

APPENDIX B - Pre-training document

PRE-TRAINING - BASIC INFORMATION ON EXCEL SOFTWARE

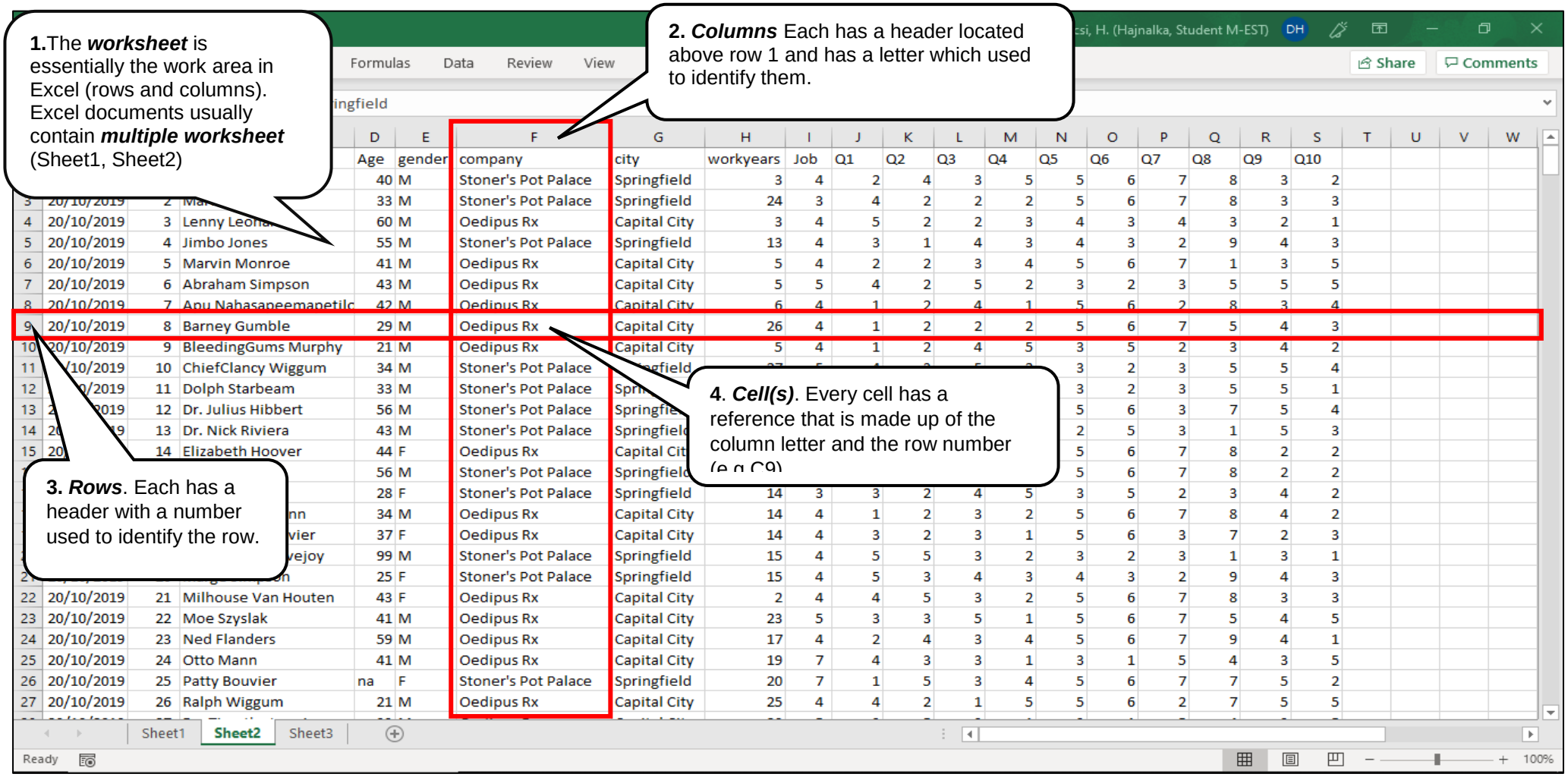
Hello and welcome to this pre-training session on Excel!

You may have already used excel so you know how efficient it is for data preparation and analysis. If you have never used it before, believe me, you will quickly get the hang of it. And hopefully you will use it to get your dataset right before using any statistical software.

Let's quickly review the interface and some of the basic concepts in excel that you will hear in the videos.

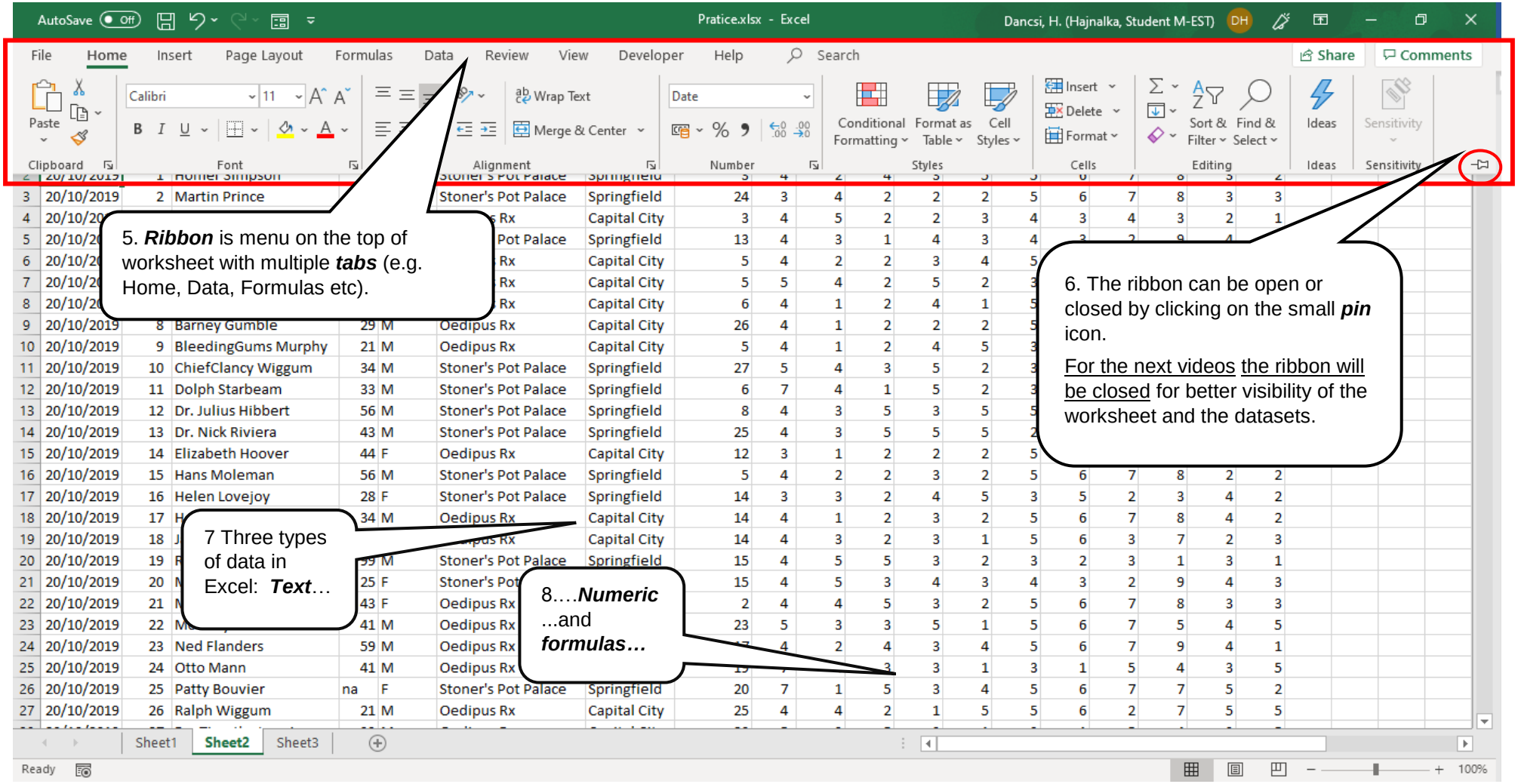
Move onto to next page.

Worksheet 1: Row, Column & Cell



	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
	Age	gender	company	city	workyears	Job	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
	40	M	Stoner's Pot Palace	Springfield	3	4	2	4	3	5	5	6	7	8	3	2
	33	M	Stoner's Pot Palace	Springfield	24	3	4	2	2	2	5	6	7	8	3	3
	60	M	Oedipus Rx	Capital City	3	4	5	2	2	3	4	3	4	3	2	1
	55	M	Stoner's Pot Palace	Springfield	13	4	3	1	4	3	4	3	2	9	4	3
	41	M	Oedipus Rx	Capital City	5	4	2	2	3	4	5	6	7	1	3	5
	43	M	Oedipus Rx	Capital City	5	5	4	2	5	2	3	2	3	5	5	5
	42	M	Oedipus Rx	Capital City	6	4	1	2	4	1	5	6	2	8	3	4
	29	M	Oedipus Rx	Capital City	26	4	1	2	2	2	5	6	7	5	4	3
	21	M	Oedipus Rx	Capital City	5	4	1	2	4	5	3	5	2	3	4	2
	34	M	Stoner's Pot Palace								3	2	3	5	5	4
	33	M	Stoner's Pot Palace								3	2	3	5	5	1
	56	M	Stoner's Pot Palace								5	6	3	7	5	4
	43	M	Stoner's Pot Palace								2	5	3	1	5	3
	44	F	Oedipus Rx								5	6	7	8	2	2
	56	M	Stoner's Pot Palace								5	6	7	8	2	2
	28	F	Stoner's Pot Palace	Springfield	14	3	3	2	4	5	3	5	2	3	4	2
	34	M	Oedipus Rx	Capital City	14	4	1	2	3	2	5	6	7	8	4	2
	37	F	Oedipus Rx	Capital City	14	4	3	2	3	1	5	6	3	7	2	3
	99	M	Stoner's Pot Palace	Springfield	15	4	5	5	3	2	3	2	3	1	3	1
	25	F	Stoner's Pot Palace	Springfield	15	4	5	3	4	3	4	3	2	9	4	3
21	43	F	Oedipus Rx	Capital City	2	4	4	5	3	2	5	6	7	8	3	3
22	41	M	Oedipus Rx	Capital City	23	5	3	3	5	1	5	6	7	5	4	5
23	59	M	Oedipus Rx	Capital City	17	4	2	4	3	4	5	6	7	9	4	1
24	41	M	Oedipus Rx	Capital City	19	7	4	3	3	1	3	1	5	4	3	5
25	na	F	Stoner's Pot Palace	Springfield	20	7	1	5	3	4	5	6	7	7	5	2
26	21	M	Oedipus Rx	Capital City	25	4	4	2	1	5	5	6	2	7	5	5

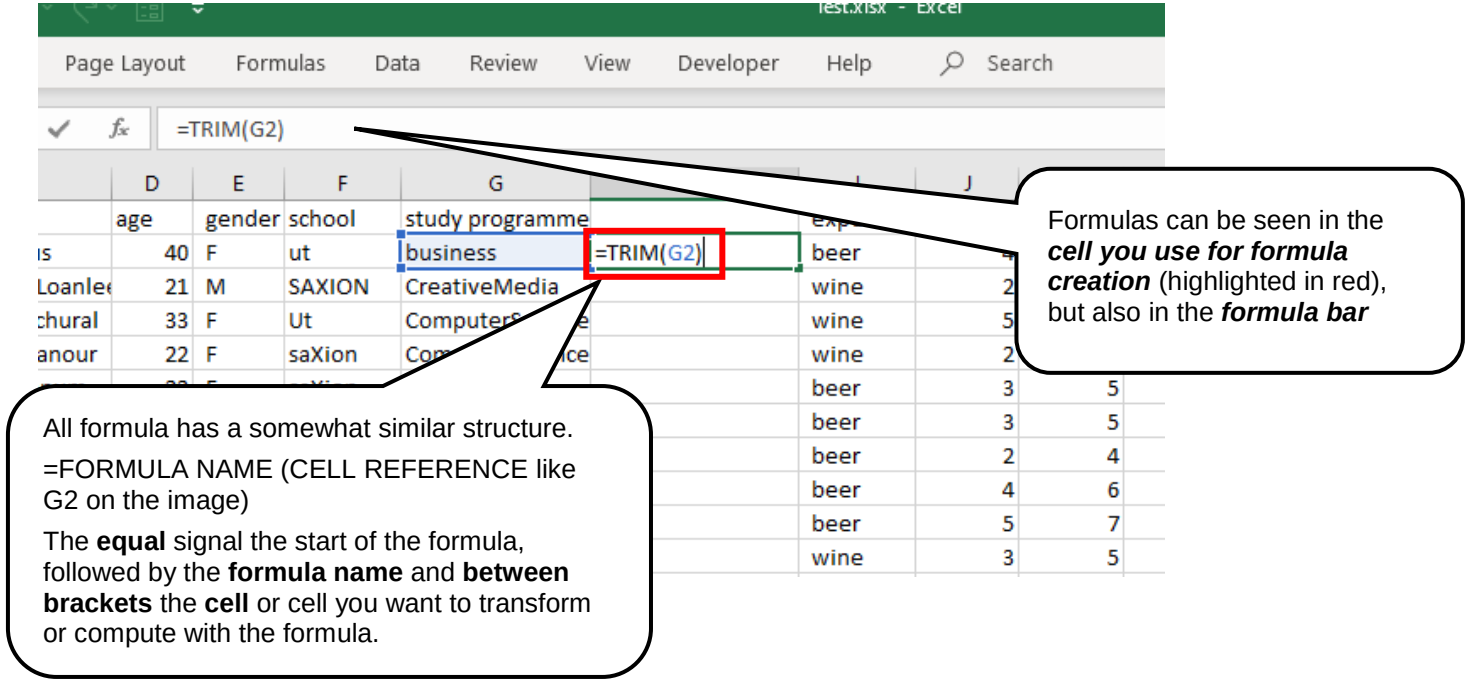
Worksheet 2: Ribbon & data types



Formulas

You can quickly transform or compute your data values with formulas.

There are many predefined formulas in Excel for statistical or mathematical computation, but also change your text values in your data set. The below example is for illustration purposes only.



Lastly, do not worry, you do not need to know all formulas, Excel suggest plenty support while you are creating one in the worksheet.

***

Now you are ready to learn some simple tricks for your data collection!

APPENDIX C - Competition analysis

	1	2	3	4	5	6
Link	https://www.youtube.com/watch?v=JNZqRYkgZ4c	https://www.youtube.com/watch?v=6V8OTiImHmk	https://www.youtube.com/watch?v=svJt4BJBkf8	https://www.youtube.com/watch?v=soX8pYY5-08	https://www.youtube.com/watch?v=i5WiYh2jmG8	https://www.youtube.com/watch?v=CYqM-YdyyQc
#Viewing	217,196	3,029,393.00	166,222.00	282,799.00	164,867.00	301,164.00
Publish Data	2018	2011	2018	2012	2012	2013
#Likes	2,300	675	327	822	9,500	171
#Dislikes	73	32.00	54.00	52.00	256.00	33.00
Title of video	Excel Magic Trick 1242: Transform Large Data Set to Final GDP Report: TTC, MATCH, Filter & Format	Learn Excel - Changing Case in Excel: Lower, Upper, Proper: Podcast #1356	Excel Change Case with or Without Formula - Upper, Lower, Title Case	Excel Filter Tutorial	Excel Data Analysis: Sort, Filter, PivotTable, Formulas (25 Examples): HCC Professional Day 2012	How to Change Caps to Lowercase in Excel
Length of video	long, >5 min	Ok, < 5 min	long, >5 min	long, >5 min	long, >5 min	1.06
Method Used (menu or keyboard shortcut or else)	Various methods. Uses menu but mentions keyboard shortcut as well (without displaying it on screen)	offers 1 method of formula creation - right in the cell, not in formula bar or else.	1 method per formula, typing directly in the cell (explains this to 3 different formulas). Simplex to complex explains how to use filter	Explains how to use it from the menu	Explains how to use it from the menu, does mention all sort of shortcuts	1 method per formula, typing directly in the cell (explains this to 3 different formulas). Simplex to complex explains how to use filter
Preview of task (before and after goal accomplishment)	none	none	none	none	none	none
Example used in the tutorial	realistic	not realistic	realistic	realistic	realistic	not realistic
Prior knowledge requirement mentioned	no	no	no	no	no	no

Action steps ordered and numbered	not used	not used	not used	not used	not used	not used
Goals and sub goals (3-5 steps)	none	none	none	none	none	none
Action vs system Reaction explained	It does mention some of the system reactions but only if he uses it in his example, else it goes unnoticed.	none	none	none	none	none
Pace of Instruction (image and narration)	Moderate but no break	Perfect (moderate, easy to follow) - note: easy to follow if you are not a total beginner. He uses subtasks that are not known to new users.	Perfect (moderate, easy to follow)	Shifting quite a lot (going back and forth of what we had and what we have)	Fast	Very fast
Error information provided	none	none	none	none	none	none
Pause (for reflection of user)	None	none	none	none	none	none
Length	long, >5 min	Ok, < 5 min	long, >5 min	long, >5 min	long, >5 min	Ok, <5 min
Signalling	No signalling used	No signalling	Yes, zooming in only	No signalling	No signalling	No signalling
Coherence	The narrator is in the front. The screen is behind him and that is somewhat disturbing in terms of visibility	Distraction in visuals -the narrator and the room he is in is visible in the right left corner of the video. The decoration of the room drives attention more to that image than to the formula	No distraction in narration or visuals	No distraction in narration or visuals	No distraction in narration or visuals	No distraction in narration or visuals
Segmenting	No	No	No	No	No	No

Sync of visuals and voice (contiguity**)**	In sync	In sync	In sync	In sync	In sync	In sync
Voice	Non-native, English, male	Native, English, male	Native, English, male	Native, English, male	Native, English, male	Native, English, male
Personalization	First or second person	First or second person	First or second person	First or second person	First or second person	First or second person

	7	**8**	**9**	**10**	**11**	**12**
Link	https://www.youtube.com/watch?v=neDUOYk8hyU&t=192s	https://www.youtube.com/watch?v=D81rxIxCcYk	https://www.youtube.com/watch?v=37kwwEeFKvY	https://www.youtube.com/watch?v=hmizmgOjNYo	https://www.youtube.com/watch?v=BpfqN2wPD1g	https://www.youtube.com/watch?v=iTraG7F2_FY
#Viewing	580,618	314,418	301,031	229,450	130,872	156,858
Publish Data	2008	2018	2009	2012	2012	2013
#Likes	1200	2900	574	277	226	160
#Dislikes	127	63	31	28	63	27
Title of video	Convert text to columns in Excel	MS Excel - Text to Columns	How to Import a Text File into Excel and Change Rows to Columns	Excel: Using Find and Replace	Excel - Find and Replace trick	How to Find and replace data in Excel 2010
Length of video	long, >5 min	long, >5 min	long, >5 min	OK, <5 min	long, >5 min	OK, <5 min
Method Used (menu or keyboard shortcut or else)	Offers 1 method. Uses menu	Shows multiple ways of using the function	Shows 2 options of using the function	Explains how to use it from the menu	Explains how to use it from the menu	Explains how to use it with keyboard shortcut only
Preview of task (before and after goal accomplishment)	none	none	none	none	none	none
Example used in the tutorial	realistic	realistic	Not realistic	realistic	realistic	realistic

Prior knowledge requirement mentioned	no	no	no	no	no	no
Action steps ordered and numbered	not used	not used	not used	not used	not used	not used
Goals and sub goals (3-5 steps)	none	none	none	none	none	none
Action vs system Reaction explained		none	none	none	none	none
Pace of Instruction (image and narration)	Moderate but no break	Perfect (moderate, easy to follow)	Perfect (moderate, easy to follow)	Shifting quite a lot (going back and forth of what we had and what we have)	Moderate but no break	Perfect (moderate, easy to follow)
Error information provided	none	none	none	Yes, highlights the issue of choosing replace all in Excel	none	none
Pause (for reflection of user)	None	none	none	none	none	none
Signalling	No signalling used	No signalling	Yes, zooming multiple times and uses yellow highlight for the mouse	No signalling	No signalling	No signalling
Coherence	No distraction in narration or visuals	The narrator is in the front. The screen is behind him and that is somewhat disturbing in terms of visibility	The continuous zoom in and out is somewhat disturbing	No distraction in narration or visuals	No distraction in narration or visuals	No distraction in narration or visuals
Segmenting	No	No	No	No	No	No
Sync of visuals and voice (contiguity**)**	In sync	In sync	In sync	In sync	In sync	In sync
Voice	Native, English, male	Non-native, English, male	Native, English, male	Native, English, female	Native, English, male	Native, English, male

Personalization	First or second person	First or second person	Uses “we”	First or second person	First or second person	First or second person