IO3

IO3. Testing of the prototype in schools

IO3.A1.2 Guidelines for School Teachers

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1. Introduction

The serious game Dig4Life has been developed in the context of the project Erasmus+ Dig4Life - Digital for Literacy and Future Education (2020-1-IT02-KA201-079420) - as a tool to self-evaluate the students' digital competence level according to the Digital Competence Framework for Citizens (DigComp), a reference framework developed to support the development of digital competence of individuals in Europe.

There are several projects and resources to evaluate the citizens' digital competences such as the Programme for the International Assessment of Adult Competences (PIAAC) and the Digital Competence Framework for Educators (DigCompEdu) questionnaire (DigCompEdu Check-In). Despite the usefulness of these resources, we have developed a serious game to evaluate the digital competences of the students because games are resources that are close to teenagers and they are part of their daily lives. Besides, games retain players attention for longer periods, give players instant feedback on their progress and allow them to overcome challenges while having fun.

The present document aims to serve as a guide for teachers, tutors and school mediators in their use of the Dig4Life serious game in class, providing them with support to plan and carry out the class sessions in which the students will use the serious game to assess their level of proficiency in digital competences.

1.1. DigComp and student's digital competence

The Digital Competence Framework for Citizens, also known by its acronym DigComp, supports the development of digital competences of individuals in Europe since it provides a flexible and adaptable quality framework that describes the competences needed today to use digital technologies in a confident, critical, collaborative and creative way to achieve goals related to work, learning, leisure, inclusion and participation in our digital society. DigComp aims to be a tool to improve citizens' digital competence, to help policy-makers to formulate policies that support digital competence building, and to plan education and training initiatives to improve digital competence of specific target groups. It focuses on people and the skills we need to be creative, to communicate more effectively and solve problems through digital technology.

This model is being used in different domains where digital competence is increasingly important such as education and training, life-long learning and inclusion, and employment. The adoption of DigComp in the education and training scope provides an essential guide and support in the design of actions to develop students' digital competence. Besides, the framework can be used to assess the digital competence level, strengths and weaknesses of students, and identify where to focus efforts to improve their digital competences.

DigComp sets out 21 different digital competences in 5 key areas that describe what it means to be digitally competent and offers a common reference at European level (see Table 1). The competence areas 1, 2 and 3

deal with competences that can be traced back to specific activities and uses. Competence areas 4 and 5 are "transversal" as they apply to any type of activity carried out through digital means. Each competence has associated learning outcomes mapped from the most basic to highly specialised level (foundation, intermediate, advance and highly specialised).

Table 1: Competence areas and digital competences of DigComp

Competence areas	Digital competences
1. Information and data literacy	Browsing, searching and filtering data, information and digital content. Evaluating data, information and digital content. Managing data, information and digital content.
2. Communication and collaboration	Interacting through digital technologies. Sharing through digital technologies. Engaging in citizenship through digital technologies. Collaborating through digital technologies. Netiquette. Managing digital identity.
3. Digital content creation	Developing digital content. Integrating and re-elaborating digital content. Copyright and licences. Programming.
4. Safety	Protecting devices. Protecting personal data and privacy. Protecting health and well-being. Protecting the environment.
5. Problem solving	Solving technical problems. Identifying needs and technological responses. Creatively using digital technologies. Identifying digital competence gaps.

The rest of the document is structured as follows. *Section 2* describes the serious game Dig4Life as a tool to assess the digital proficiency level of students: description of the game episodes, rules of the game and technical requirements. *Section 3* includes several guidelines about the use of the serious game in the class. *Section 4* includes a guide about collecting the answers to the students' questionnaire and providing feedback as a teacher to assess the serious game experiences conducted on both schools and dual vocational training systems. Finally, the references are included in *Section 5*.

2. Dig4Life Game as a tool to assess student's digital competence

The serious game Dig4Life has been developed as a tool to self-evaluate student's digital competence on the basis of DigComp. The serious game consists of six episodes that allow students to assess their level of digital proficiency in the five competence areas of DigComp as well as the competence Digital Numeracy. Though the competence Digital Numeracy is not explicitly addressed in DigComp, it has been included in the game since numeracy is important to young people at all educational levels as a basic resource that is used in the whole school curriculum. It is a relevant life skill that includes a range of competences related to mathematics such as: interpreting plans, maps, charts and diagrams, processing information accurately, solving problems and puzzles, decision-making based on logical thinking and reasoning, etc.

2.1. Context and characters

The game has been developed in a digital future characterized by a modern and technological e-society. Schools as we know do not exist, there are no classrooms, lecturers or homeworks. Students reside on school campuses spending three, four or five years, during this time they will have to deal with real life challenges that constitute a futuristic form of informal training. The main characters of the storyline live on a school campus and must test several digital skills to advance within the story, as well as complete missions and solve challenges. A mentor interacts as a hologram to give feedback according to the player's behaviour and final score.

The characters that appear in the game storyline are as follows: Paul (teenage boy), Francis (teenage girl), Chris (young non-binary - male - with a high level of robotics knowledge), Michela (young woman that is an ethical hacker), David (teenage boy that is a cybercriminal and bully), Bensy-Pi (an elder Nobel-prize lady), Arcimede - nickname Arci - (drone with a virtual leash associated with Paul), Casiemede - nickname Casie - (new model drone with emotional feelings like humans) and the Mentor (middle-age man that provides feedback to the players).

2.2. Episodes of the game

Each episode focuses on a specific digital competence area and its storyboard has been co-designed by each one of the project's partners and the teachers involved: Episode 1. Digital Safety (Italia), Episode 2. Digital Communication and Collaboration (Spain), Episode 3. Digital Creativity (Finland), Episode 4. Digital Literacy (Austria), Episode 5. Digital Numeracy (Lithuania) and Episode 6. Digital Problem Solving (Slovenia).

The storyline of the episodes unfolds in several scenes and a final epilogue where the mentor gives feedback to students about the level they have in the digital competences evaluated in the episode.

2.2.1. M
onday - Digital Safety

- *Storyline and characters*

Someone hacked Paul's DigiGram account and posted an offensive post about his friend Laura, and Paul has to decide what to do to protect his account. Paul must apologize to Laura through DigiGram taking care not to violate her privacy. Besides, Paul is bulled by a cyber buller at DigiGram since his account was hacked and he must decide what to do. On the other hand, Paul receives an email about the delivery of some products that he has not purchased so he doubts whether to open it or not. The order has been made by the refrigerator since it has an artificial intelligence system that makes orders automatically and Paul has to change the settings on the SmartFridge. Besides, Paul and Francis report on the progress of their academic work on cryptocurrencies, and they have to choose the best way to save the file they are working with and further actions to performance. Additionally, Paul and Francis receive an email with an offer of 80% off their favourite game console and they have to decide if to accept the offer or not. Paul has problems with his smartphone and they go to the laboratory of Michela for help. Michela sends them the coordinates of her laboratory and since the battery of Paul's phone is very low he has to devise how to save battery. Michela fixs Paul's mobile and proposes to find out if the hacker and the person who sent the email with thf game console offer are the same person. Finally, Michela asks Paul and Francis if they know what "crypto mining" is and she asks them if they want to investigate with her in "crypto mining".

The characters of this episode are as follows: Paul, Francis, Arci, Michela, David and Mentor.

- *Competences and behaviours*

Table 2 contains the specific digital competences and behaviours of the competence area Digital Safety that are assessed in Monday episode.

Table 2: Digital competences and behaviours of episode Monday - Digital Safety

Digital competence	Behaviour
Protecting devices	To periodically adjust privacy settings. To use two.factors authentication. To use complex passwords. To use multiple platforms to save important files.
Protecting personal data and privacy	To recognize suspicious activity (phishing, malware, ransomware, etc.). To respect others' privacy and personal content. To verify the reliability of websites that request personal information.
Protecting health and well-being	To be aware of social network netiquette to avoid posting inappropriate or potentially offensive content. To protect self and others from cyberbullying.
Protecting the environment	To switch off unused devices. To avoid practices with a high environmental impact, such as the use of cryptocurrencies. To avoid buying new devices if not necessary.

- *To access the episode Monday - Digital Safety:*

  Each partner will include the concrete manner to access the episode.
- *Estimated time to complete the episode:* 20-25 minutes.

2.2.2. Tuesday - Digital Communication and Collaboration

- *Storyline and characters*

Arci crashes into a window chasing a fly and it does not work well. Paul jokes about the artificial intelligence applied to Arci, the drone gets angry and challenges Paul to investigate the artificial intelligence that controls its operation. Paul asks Francis to collaborate with him to repair Arci but there are problems that they do not know how to solve and ask Chris, a robotics expert, for help. Arci is surprised by the quality of the work that the team is doing and proposes it to share the study results document on the internet. Paul decides to put into practice the knowledge he has learned to repair Arci, but something goes wrong and Arci shuts down and stops working. Paul emails the Dra. Bensy Pi who was involved in the design of Arci and she offers to help them. Paul convokes an online meeting with the Dra. Bensy Pi and she gives the team the necessary information to repair Arci.

The characters of this episode are as follows: Paul, Chris, Francis, Arci, Bensy Pi and Mentor.

- *Competences and behaviours*

This episode focuses on the competence area Digital Communication and Collaboration. The specific digital competences and behaviours that have been considered in this episode are described in Table 3.

Table 3: Digital competences and behaviours of episode Tuesday - Digital Communication and Collaboration

Digital competence	Behaviour
Interacting through digital technologies	To select the most appropriate tool to interact and communicate (email, forum, chat, videoconference, etc.). To know how to set up a video conference for a specific date.
Sharing through digital technologies	To distinguish between different technologies for exchanging content. To select the appropriate tool to share the digital content and he correctly justifies his selection. To be aware of the meaning and of the fact that sharing content implies attributing to its authors.
Engaging citizenship through digital technologies	To distinguish between different technologies to interact with services, such as banks, medical centers or governments.
Collaborating through digital technologies	To understand the dynamics of collaboration work and to distinguish between different technologies to put them into practice. To select and use simple digital tools to work collaboratively using basic collaborative functions (control of changes, comments, labels, etc.).
Netiquette	To recognize appropriately the basic principles of netiquette in digital communication (eg. capitalization, emoticons, spelling). To use and adequately recognize the principles of communication, netiquette and writing depending on the means of communication (eg. email, blog, social networks). To be aware that the mode of communication must be different depending on the audience. To be able to distinguish and appreciate digital communication adapted to diversity.
Managing digital identity	To recognize the benefits of having a digital identity. To develop a digital profile that meets their needs and tracks their fingerprint. To know how to protect their digital identity through simple techniques and understand the relationships between the online and offline world.

- *To access the episode Tuesday - Digital Communication and Collaboration:*

  Each partner will include the concrete manner to access the episode.
- *Estimated time to complete the episode:* 20-25 minutes.

2.2.3. Wednesday - Digital Creativity

- *Storyline and characters*

Paul and Francis are making a presentation about copyright and licensing, and they notice that Arci has purchased without permission an update program of his computer system to make himself invisible. They modify the update program to teach Arci a lesson, and after downloading the program the dron does not stop spinning surrounded by soap bubbles and a rainbow, and making funny elephant noises. Paul and Francis want to share a funny video of Arci, and they have to decide how to turn it into an NFT and auction its property. After that, Paul and Francis have to decide how to stop Arci from purchasing online updates for its system without permission. Next, Francis proposes to develop a program for Arci to help them in their digital creativity projects and they have to decide which technologies to use. On the other hand, Arci records a video of Paul and Francis to upload it to Youtube, but the dron does not understand about copyright and has used a song by rapper Williams. Paul and Francis have to decide what changes to make to Arci's computer system so that it learns to respect copyright in digital creations. Next, Francis proposes going to a music festival and they have to decide how to get information about the possible concerts they can go to.They discover that there is a new platform, DigiStar, in which the artist appears as a hologram and have to decide both how to buy tickets for the Williams' concert and where to find the link to the concert. After the concert, Francis and Paul have to finish the copyright and licensing presentation and answer a questionnaire prepared by Arci. Finally, Williams sends Francis and Paul many hearts and a virtual autograph, and they have to decide what to answer.to him.

The characters of this episode are as follows: Paul, Chris, Francis, Arci, Michela, Williams and Mentor.

- *Competences and behaviours*

The purpose of this episode is to assess the digital competences and behaviours indicated in Table 4 which belong to the competence area Digital Content Creation.

Table 4: Digital competences and behaviours of episode Wednesday - Digital Creativity

Digital competence	Behaviour
Developing digital content	To create and edit digital content in different formats, to express oneself through digital means.
Integrating and re-elaborating digital content	To modify, refine, improve and integrate information and content an existing body of knowledge to create new, original and relevant content and knowledge.
Copyright and licences	To understand how copyright and licences apply to data, information and digital content.
Programming	To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.

- *To access the episode Wednesday - Digital Creativity:*

  Each partner will include the concrete manner to access the episode.
- *Estimated time to complete the episode*: 20-25 minutes.

2.2.4. Thursday - Digital Literacy

- *Storyline and characters*

Francis and Paul have to write a thesis and they plan to search for information on the Internet. To do this, they must consult documentation on a system that allows them to evaluate the credibility of any source of information. They must answer some questions about this system. Later, they have to make some decisions about which sources they should consult and which is the best way to present the information. Finally, they should also investigate the legal aspects of using the information they have found.

The characters of this episode are as follows: Paul, Francis, Arci, Mentor.

- *Competences and behaviours*

The episode Thursday focuses on the competence area Digital Literacy, and evaluates the digital competences and behaviours shown in Table 5.

Table 5: Digital competences and behaviours of episode Thursday - Digital Literacy

Digital competence	Behaviour
Browsing, searching and filtering data, information and digital content	To search for data, information and content in digital environments.
Evaluating data, information and digital content	To analyse, compare and evaluate the credibility and reliability of sources of data, information and digital content.
Managing data, information and digital content	To organise, store and retrieve data, information, and content in digital environments.

- *To access the episode Wednesday - Digital Creativity:*

  Each partner will include the concrete manner to access the episode.
- *Estimated time to complete the episode*: 20-25 minutes.

2.2.5. Friday - Digital Numeracy

- *Storyline and characters*

In the morning Paul wakes up and he finds out that Arci is missing. Paul receives a message reporting that Arci has been kidnapped. The message includes some mysterious instructions that might help Paul and Francis find Arci. They must first calculate how much time they have to find Arci. They meet with Michela in the cafe and while Paul explains the situation to Michela, Francis orders drinks and snacks and Paul calculates the total cost with the discount. Michela proposes to connect to the security camera to see what happened to Arci during the night. So that Michela does not have to watch the recording of the entire night, Paul analyses the instructions he received to determine what time Arci was kidnapped. Paul receives several messages that include riddles that they have to solve to find the abandoned factory where Arci is and can enter inside. Paul and Francis find an arcade machine in the factory, and they have to play several minigames to find Arci.

The characters of this episode are as follows: Paul, Francis, Michela, Arci and Mentor.

- *Levels and behaviours*

This episode focuses on the competence area Digital Numeracy and Table 6 includes the behaviours about general arithmetic considered in this episode grouped by levels.

Table 6: Levels and behaviours of episode Friday - Digital Numeracy

Level	Behaviour
0	To carry out simple arithmetic operations in familiar contexts, where the mathematical content is explicit, with little text and few elements of distraction.
1	To carry out simple mathematical processes in common, concrete contexts where the mathematical content is explicit with little text and minimal distractors. Tasks require one-step or simple processes involving counting, sorting, performing basic arithmetic operations, understanding simple percentages, and identifying elements of simple or common graphical or spatial representations.
2	To identify and act on mathematical information and ideas embedded in a range of common contexts where the mathematical content is fairly explicit or visual with relatively few distractors. Tasks require the application of two or more steps or processes involving calculation with whole numbers and common decimals, percentages and fractions; simple measurement and spatial representation; estimation; and interpretation of relatively simple data and statistics..
3	To understand mathematical information that may be less explicit, embedded in contexts that are not always familiar and represented in more complex ways. Tasks require several steps and may involve the choice of problem-solving strategies. Tasks tend to require the application of number sense and spatial sense; recognizing and working with mathematical relationships, patterns, and proportions expressed in verbal or numerical form. Besides, the tasks can require basic analysis of data and statistics in texts, tables and graphs.
4	To carry out operations by extrapolating mathematical information through a process of interpretation and inference. Activities at this level require the respondent to understand complex representations and abstract and formal mathematical and statistical ideas embedded in complex texts.

- *To access the episode Friday - Digital Numeracy:*

  Each partner will include the concrete manner to access the episode.
- *Time to complete the episode*: 20-25 minutes.

2.2.6. Saturday - Digital Problem Solving

- *Storyline and characters*

Francis is sleeping in her room in an agitated way. Her new drone, Casie, is on her side because it feels that Francis is having bad dreams. Francis turns around suddenly and crushes Casie, breaking one of its propellers. Francis and Paul have to decide what to do in order to analyse the situation and repair the Cassie propeller. Since Francis and Paul don't know how to repair that new drone's model, they visit Michela's lab to find the information and tools needed to repair Casie.

The characters of this episode are as follows:Paul, Francis, Michela, Arci, Casi and Mentor.

- *Competences and behaviours*

Table 7 contains the specific digital competences and behaviours of the competence area Digital Problem Solving regarded in this episode.

Table 7: Digital competences and behaviours of episode Saturday - Digital Problem Solving

Digital competence	Behaviour
Solving technical problems	To identify technical problems when operating devices and using digital environments, and to solve them.
Identifying needs and technological responses	To identify, evaluate, select and use digital technologies and possible technological responses to solve a given task or problem.
Creatively using digital technology	To use digital technologies in innovative ways to create knowledge.
Identifying digital competences gaps	To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up-to-date with the digital evolution.

- *To access the episode Saturday - Digital Problem Solving:*

  Each partner will include the concrete manner to access the episode.
- *Time to complete the episode*: 20-25 minutes.

2.3. Rules of the game

Players can play the serious game episodes in any order since each episode addresses a concrete digital competence area and the episodes are independent of each other. To play an episode, the player has to access a specific url and enter his name. If the player wishes to leave the game, he can continue at any time where he left off but he cannot go back in the storyline, to do so, he should start again at the beginning.

The storyline of each episode is developed through several scenes that are composed of regular dialogues, interactive dialogues and actions/decisions:

- *Regular dialogues*.

  Regular dialogues can be carried out speaking the characters or textually via a device (WhatsApp, Chat, Telegram…). They are fixed and not subject to the player's choice.

- *Interactive dialogues*.

  Interactive dialogues are dialogues in which the player must decide how the character replies in a certain situation. The player usually has to choose between 3 and 5 options, and each option has associated a concrete score for the digital competence evaluated in the interactive dialogue.

- *Actions/Decisions*.

  In actions/decisions the player has to perform a specific task (ordering items, choosing items for a list, etc.). Depending on the results of the task, the player obtains a specific score for the digital skill assessed in the action/decision.

The episode storyline is interrupted by interactive dialogues and actions/decisions, and the feedback that immediately follows each of them will depend on the player's choice. The narrative then converges to the main storyline so each player will experience the same story with few differences based on their decisions. When the characters stop talking, the player can click on any of them to listen to the last sentence or the last dialogue.

At the end of each episode, the mentor gives feedback about the level of the player regarding each digital competence assessed in the episode. The specific mentor's feedback depends on the percentage of points that the player has achieved. Likewise, for each digital competence evaluated the following information is displayed: the maximum score assigned to the competence, the points achieved by the player in the competence and the percentage of points obtained by the player with respect to the maximum competence score. The maximum total score that a player can get in each episode is 100 points. If the player clicks on one of the digital competences, the competence description is displayed.

Next, the options of the game menu and the buttons that can appear in the interactive dialogues, actions/decisiones, instructions and other windows of the episodes are described.

- *Game menu*

The menu of the game is displayed at the bottom of the screen and contains the options described in Table 8.

Table 8: Menu options

Option	Description
	Resume an interrupted interview.
	Pause the game.
	Resume the game.
	Show the speech captions.
	Open or close the instructions.
	Start over.
	Exit the game. The player can re-enter later and continue playing in the place that stayed.

Selecting the option “Instructions”, the following information is displayed: description of the scenario in which the game takes place, description of the characters of the episode, objective of the episode and the competence area in which it focuses, explanation of menu options and buttons.

- *Buttons*

Table 9 contains the description of the buttons that can appear In the interactive dialogues, actions/decisiones, instructions and other windows.

Table 9: Buttons

Button	Description
	Turn off.
	Confirm the answer.
	Next page.
	Previous page.

- *Important considerations:*
  - Do not close the virtual learning platform leaving the game open. Exit the game before closing the virtual learning platform.
  - Exit the game if you stop playing so that the game time stops.
  - Play each episode until the scores chart appears. Otherwise the game will not record the player's final rating .

2.4. Technical requirements

The students can play both in presence and in remote teaching, and the technical requirements are the following:

- Devices that can be used: tablet and PC.
- It is necessary to have internet access.
- Browsers that can be used: Chrome, Firefox and Edge.
- Change the browser options to allow pop ups.
- It is recommended clearing the cache each time the player starts a new episode.

3. Using the Dig4Life serious game in the class

The game has been developed to address the evaluation of the digital competences listed in section 1.1, one of them in each episode. Dig4Life can be used as a whole product used to evaluate all the competences during an

academic year or it can be used to assess a specific area competences in an isolated experience as well. Thus, before starting the experience in class, teachers should test the episodes of the game to planify the class sessions depending on the time availability and needs of the syllabus.

3.1. Structuring the class session with the students

Before starting the first class session with the game, teachers should introduce the game to the students: narrative context and characters (section 2.1), game episodes (section 2.2), game rules (section 2.3) and technical requirements (section 2.4). Each class session should evaluate one competence area by using the corresponding episode. The first episode should be played in class, the rest of them could be carried out in or out of class depending on time restrictions.

For each class session the structure should be:

1. 4 (see section 2.2).
2. The teacher summarises the general context of the episode storyline.
3. The teacher provides students the link to access the game episode.
4. The students play the game individually for the first time.
5. In the light of the results obtained, the teacher helps to interpret them by providing feedback to the students.
6. The teacher can conduct a debrief phase about the experience and propose improvement activities to the students

At the end of all the planned game sessions, the teacher should provide the link to the student´s questionnaire. As well, the teachers should also answer the teacher´s questionnaire. The links will be provided in the next section.

4. Assessing the experience

As we mentioned above, once the game sessions are finished, both teachers and students should answer an evaluation questionnaire. The results obtained in the questionnaires will be treated anonymously to assess the experience in the context of the Erasmus project.

When the links are published, the questionnaires will be available for one week and they could be answered in 5-10 minutes. Before starting the answer, you should choose the language of the questionnaire (English, Spanish or Italian). The questions are organised by blocks and it is necessary to answer one block in order to move on to the next one. At any time it will be possible to leave the questionnaire and **CONTINUE** it later where you left off; finished answers will remain stored.

4.1. Student's questionnaire

The objective of this questionnaire is to evaluate the student's experience with the game. The questionnaire assesses both, usability and user engagement.

- *The link to the questionnaire is as follows:* https://www.surveymonkey.com/r/YRQK9QV

As we access the link, we will find the welcome screen to the questionnaire and we can start the answer by pressing the next button.

The questionnaire consists of four blocks of questions.

1. The first block includes 6 questions about personal data: country, study center, age, etc.
2. The second block is about the game usability. It includes 12 questions that should be answered in a likert scale from five possible answers (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree)
3. The third block includes 16 questions about the user experience as a player, and should be answered in a likert scale from five possible answers from strongly agree, to strongly disagree.
4. Finally, the last block is to express your personal opinion about the game.

4.2. Teacher's questionnaire

The objective of this questionnaire is to obtain the teacher's perception on the students participation as well as the teacher's opinion about the experience.

- *The link to the questionnaire is as follows*: https://www.surveymonkey.com/r/MB5X3VD

As we access the link, we will find the welcome screen to the questionnaire and we can start the answer by pressing the next button.

This questionnaire consists of 4 blocks of questions:

1. The first block includes 9 personal questions:country, workplace, sex, age, etc.
2. The second block includes 10 questions about the perception of the student's participation and should be answered in a likert scale from five possible answers (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree)
3. The third block includes 22 questions related to the teacher's experience and should be answered in a likert scale from five possible answers from strongly agree, to strongly disagree.
4. Finally, the fourth block is intended to collect comments.

4.3.

Providing feedback as a teacher

At the end of all the planned game sessions, in the light of the results obtained by the students, the teacher helps them to interpret their results and provide a more complete feedback to the students.

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