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USING AN ANIMATED PEDAGOGICAL AGENT TO SUPPORT MOTIVATION,
REFLECTED IN TASK PERSISTENCE, BY DELIVERING FORMATIVE ASSESSMENT
AT CLASSROOM LEVEL

MA thesis

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Abstract

Animated pedagogical agents (APA) have the potential to support students' motivation during formative assessment processes (i.e., feedback). However, APA has been used mainly at the student individual level, overlooking opportunities to deploy this technology in a classroom workflow. Therefore, the objectives of this thesis are twofold: (1) examining the potential benefits of APAs in professional practice, and (2) exploring whether APA-driven feedback supports students' motivation reflected in task persistence compared to teacher-driven feedback. To that end, a quasi-experiment study design was conducted with 61 fifth-grade students from a public school in Turkey. The results showed that students' experienced formative assessment given by an APA similarly to how the teacher did. Regarding the students' motivation, expressed in task persistence, the results showed no correlation, suggesting that expressed motivation does not necessarily reflect students' effort in follow-up activities after receiving the formative assessment by the teacher or the APA. Finally, from the teacher's point of view, the APA has the potential to assist the teacher effectively. However, how to tackle challenges in relation to students' profiles and preferences to adopt this technology. still need further investigation.

Keywords: Animated Pedagogical Agent, Formative Assessment, Feedback, Motivation, Task Persistence

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1. Introduction

1.1 Background of the Study

In virtue of rapid advances in technology, considerable literature has grown up around the theme of integrating animated pedagogical agents (APAs) in teaching and learning practices. (Arguedas & Daradoumis, 2021; Atkinson, 2002; Lester et al., 1997; Roa et al., 2021). Animated pedagogical agents are lifelike autonomous characters that cohabit learning environments with students aiming to create rich, face-to-face learning interactions (Johnson et al., 2000). Recent technological improvements in the APA field, suggest that APAs could serve as significant factors for uplifting students' motivation, thus, increasing the learning opportunity (Hong et al., 2014). Literature around APAs is multi-faceted, and researchers have conducted studies from various perspectives, such as the effectiveness of APAs on learner motivation, emotion, and well-being (Arguedas & Daradoumis, 2021; Chin et al., 2016; Horovitz & Mayer, 2021; Lin et al., 2020). Moreover, the impact on students' learning outcomes and performance is another major area of interest within the field of APAs (Carlotto & Jaques, 2016; Grivokostopoulou et al., 2020; Johnson & Lester, 2016; Yung & Paas, 2015). Pedagogical roles an APA could play at a student-level interaction are well known (i.e peer, tutor, mentor, etc), (Kim & Baylor, 2016; Peng & Wang, 2021). However, recent studies have also gained interest in what roles would be needed to empower teacher practice at a classroom level (Roldan et al., submitted, under revision)

Despite the related benefits associated with the use of APAs, there is the need to better understand how this technology could support teachers in classroom workflows and not only individual student activities settings. Exploring possibilities on how an APA could assist teachers, might alleviate classroom orchestration loads (Dillenbourg, 2010). Therefore, one of the scopes of this study is on how, and to what extent, APAs could be perceived similarly to teachers, or trusted assistants of teachers when students receive formative assessment from the agent. The second scope is to explore if the resulting motivation expressed by students when interacting with the agent, can be reflected in task persistence effort on a follow-up activity after the interaction. Finally, as a reflective outcome on how APAs could collaborate and empower teachers in their practice, the author of this work reflects on the experience of using APA technology as part of pedagogical endeavors, and what challenges are needed to be addressed when incorporating APA technology at classroom level.

Previous studies proved that feedback, as a formative assessment mechanism, helps learners to fill the gap between what they already know and what they do not know. However, how the feedback might be adapted interactively by an APA in the classroom is limited(Cunha et al., 2019; Högemann et al., 2021). In addition, much uncertainty still exists about the relation between the given feedback and the effort in task persistence in subsequent activities. Research to date has not yet determined to what extent APAs, whose role in this work is to collaborate and assist the teacher in delivering feedback as formative assessment, impact students' intrinsic motivation.

There is increasing consensus that feedback is one of the critical constituents of effective learning (Winstone et al., 2017). How APAs are combined with instructional design targeting classroom workflows has long been a question of great interest with similar technology (Yasef, 2002).

This thesis addresses the following four questions:

RQ 1. How formative assessment (feedback) affects student performance in terms of learning outcomes?

RQ 2. How do students experience and get motivated through the process of formative assessment delivered by the APA compared to a teacher?

RQ 3. How do students' expressed motivation when receiving formative assessment is reflected in task persistence when engaging in follow-up activities?

RQ 4. What are the opportunities and challenges a teacher could encounter when integrating APA technology in the classroom?

This thesis contributes to the area of the APA field by investigating how the motivation of the students is affected when formative assessment is delivered by an agent assisting the teacher at the classroom level. The objectives of this work are twofold: (1) examining the potential benefits of APAs in professional practice, and (2) exploring whether APA-driven feedback supports students' motivation reflected in task persistence compared to teacher-driven feedback.

1.2. Motivation for the Research

The main reason for choosing this topic is personal experience concerning the link between APAs and intrinsic motivation. A recent study shows that there is a low correlation between achievement and intrinsic motivation among middle school learners in Turkey (Karaman et al., 2019). To tackle this, innovative strategies using APA technology could jointly enhance students' intrinsic motivation while supporting the teacher in the classroom.

The findings are expected to contribute to the field of APAs and feedback within the context of formative assessment. Furthermore, the results of this study could benefit instructional designers not only for foreign language teaching purposes, but also for various disciplines in education.

It is now well established from a variety of studies, that APAs affect both learners and the learning environment positively. Previous research comparing affective and cognitive feedback provided by an APA has found that this technology is more effective in terms of improving learners' emotional, social, and cognitive well-being (Arguedas & Daradoumis, 2021). Additionally, other authors point out that APAs can improve students' learning experience, and enhance their engagement with learning activities, and overall performance (Grivokostopoulou et al., 2020).

The rest of the thesis is organized as follows: Chapter two presents relevant literature and introduced the theoretical frameworks that underpin this work. Next, in chapter three, the method is described. Then, results and analysis are featured in chapter four. Finally, the discussion, conclusion, and limitations are presented in the subsequent chapters, respectively.

2. Theoretical Overview

2.1. Conceptual Framework of Formative Assessment and Applications

Formative assessment (FA) is an important topic of interest for both researchers and instructors (Gedye, 2010; Leenknecht et al., 2021; Pryor & Crossouard, 2008; Sadler, 1989). Several researchers agree that assessments become formative when the inference about a student's learning is 'elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited (Black and Wiliam 2009, p. 9). Prior definitions of FA take a similar perspective. For instance, Sadler (1989) defines FA as related to students' responses including performance and efforts to make inferences on how the teaching and learning process goes on along with improving the students' skills.

Other authors have proposed a more conditioned definition. For instance, Gedye (2010) gives a brief sight on FA as information that allows the learners to improve their learning and performance. Cauley and McMillan (2010) also designate formative assessment as an ongoing process, which is improved mainly by informal observations and verbal exchanges with students during the instruction. Besides, it has been demonstrated that the practice perspective in FA supports the integration of assessment in education (Boud et al., 2018). Moreover, Daly and colleagues (2010) follow the idea that assessment can be regarded as formative if feedback enables the learners to adapt their approach upon reflecting on the results, or the teacher reflects on the learner's practice and modifies the assessment or the task itself. Black and Wiliam (2009) created a framework for delivering FA consisting of the following strategies:

1. clarifying and sharing learning intentions and criteria for success.
2. engineering effective classroom discussions and other learning tasks that elicit
3. evidence of student understanding.
4. providing feedback that moves learners forward.
5. activating students as instructional resources for one another; and
6. activating students as the owners of their own learning.

These five strategies aim to improve instructional design for both, individual and classroom workflows. For instance, the second strategy is applied when questioning the classroom. Then, comment-only marking is a particular way that teachers might achieve the

third strategy. Similarly, peer- and self-assessment are activities that might be used to pursue the fourth and fifth strategies respectively.

Regarding applications of FA, in terms of motivation, Leenknecht and colleagues (2021) found that FA in the classroom promotes learners' intrinsic motivation. Antoniou and James (2014) conducted a qualitative study on primary school teachers' perceptions about implementing FA in their teaching practices. The results of their study showed that the primary school teachers had a positive attitude towards FA. Notwithstanding the latter finding, when digital technology is involved to support FA processes, Zhan and So (2017) identified major problems in relation to student engagement, assessment task design, and feedback. A great deal of previous research on FA takes various constituents of teaching and learning such as achievement and motivation (Cauley & McMillan, 2010; Leenknecht et al., 2021; Leighton & Bustos Gómez, 2018). However, limited research was found in the literature on combining pedagogical agents and FA (Otsuka et al., 2007).

2.2. Feedback as a Formative Assessment Mechanism

Feedback is a major component of formative assessment, and it is reviewed as one of the primary influences on learning (Hattie, 2008; Narciss, 2008; Sadler, 1989). Several studies have addressed feedback and its role in the performance, motivation, or acquisition of skills that meet the demand in pedagogy (Bruning, 2001; Hattie, 2008; Havnes et al., 2012; Narciss, 2008; Shute, 2008; Winstone et al., 2017). One of the most known researchers in the field of feedback, Hattie and Timperley (2007), conceptualized feedback as information provided by an agent such as a teacher, peer, or a book concerning one's performance or knowledge. The general conceptualization requires a specific focus in terms of designing interventions or lesson plans so that the formative aspect of feedback is reviewed to maintain the aim of the study which is to guide the following lessons. Shute (2008) defined formative feedback as information communicated with the aiming of reshaping his or her thinking or behavior in an attempt to improve learning. Literature on the field advocates that correctly delivered feedback can significantly improve learning processes and outcomes (Bruning, 2001; Cunha et al., 2019; Havnes et al., 2012).

According to Shute (2008) formative feedback, which is delivered by a teacher or computer, in the classroom or elsewhere, has the purpose to enhance targeted conceptualizations and skills. Similarly, Narciss (2008) referred to formative feedback as the output that is fed back systematically to the controller as an input signal which closes the feedback loop according to cybernetics. Also, Narciss (2008) indicates different theoretical

frameworks which attribute different functions to feedback in learning situations. These are behavioral functions (1), in which feedback aims to reinforce correct responses. Cognitive function (2), where feedback is considered a source of information necessary for the correction of incorrect responses. In Metacognitive function (3), the content-related, procedural, or strategic knowledge is provided to the learners to reach a correct result., Motivational (4) the purpose of the feedback is to maintain the level of effort.

2.3. Complexity of Feedback

Shute (2008) refers to complexity in feedback as the density of information. Despite more specific feedback might be accepted, it is not necessarily more effective under certain conditions, Shute (2008) notes that the length or complexity of the information is relevant. An example presented by Shute (2008) states that when feedback is excessively long or complicated, the attention span of the students significantly decreases, and the intended message might become meaningless. Shute (2008) draws up feedback types ordered by their complexity which are described in Table 1.

Table 1. Feedback types arrayed loosely by complexity (Shute, 2008 p.160)

Feedback Types	Descriptions
No feedback	Refers to conditions where the learner has presented a question and is required to respond, but there is no indication as to the correctness of the learner's response.
Verification	Also called "knowledge of results" or "knowledge of the outcome." It informs the learners about the correctness of their responses (e.g., right wrong, or overall percentage correct).
Correct response	Also known as "knowledge of correct response." Informs the learner response of the correct answer to a specific problem, with no additional information.
Try again	Also known as "repeat-until-correct" feedback. It informs the learner about an incorrect response and allows the learner one or more attempts to answer it.
Error flagging	Also known as "location of mistakes." Error flagging highlights errors in a solution, without giving a correct answer.
Elaborated	A general term relating to the provision of an explanation about why a specific response was correct or not and may allow the learner to review part of the instruction. It may or may not present the correct answer.

Attribute isolation	Elaborated feedback that presents information addressing central isolation attributes of the target concept or skill being studied.
Topic contingent	Elaborated feedback providing the learner with information relating contingent to the target topic currently being studied. May entail simply reteaching material.
Response contingent	Elaborated feedback that focuses on the learner's specific response. contingent It may describe why the incorrect answer is wrong and why the correct answer is correct. This does not use formal error analysis.
Hints/Cues/Prompts	Elaborated feedback guiding the learner in the right direction, e.g., prompts strategic hints on what to do next or a worked example or demonstration. Avoids explicitly presenting the correct answer.
Bugs/Misconceptions	Elaborated feedback requiring error analysis and diagnosis. It provides information about the learner's specific errors or misconceptions.
Informative tutoring	The most elaborated feedback (from Narciss & Huth, 2004), this tutoring presents verification feedback, error flagging, and strategic hints on how to proceed. The correct answer is not usually provided.

Shute (2008) shows that feedback complexity varies systematically. The lowest level was simply providing the correct answer, and the most complex feedback originated from a combination of providing correctness, and a clarification about the reason to indicate why the incorrect answer was wrong. When formative feedback serves as a corrective function, corrective information should be provided to the learner if the targeted response or action is not achieved (Shute, 2008). Several authors have considered the effects of feedback when facilitated by technology (Goldin et al., 2017; Hattie, 2008; Máñez et al., 2019; Narciss, 2008). Narciss and Huth (2004) conducted research including two computer-based tasks with feedback messages to find out the impact of the feedback on learning and motivation. The results of these studies showed that systematically designed feedback has a significant impact on achievement and motivation. Additionally, Máñez et al. (2019) found that providing students elaborative feedback improves not only their question-answering performance, but also their efficiency in evaluating textual relevance compared to a control group with no

feedback. A more detailed analyses in Hattie's (2008) database demonstrated that the most effective forms of feedback provide cues or reinforcement to learners.

2.4. Cognitive and Affective Feedback

Nelson and Schunn (2009) define affective feedback as a type of language, which consists of praise or mitigation used by an agent. The literature has established various techniques to support the affective state of the learners (Chaffar & Frasson, 2004; Forbes-Riley & Litman, 2007; Nelson & Schunn, 2009). For instance, Chaffar and Frasson (2004) proposed an Emotional Intelligent Agent, which can detect the current emotional state of the learner by the choices the learner made, and it can provide optimal affective language. Also, Forbes-Riley and Litman (2007) performed a study on how human tutors respond to the students' affective state for adaptive system development. They found that human tutors used different feedback strategies based on the students' uncertainty. Nevertheless, praise and affective language are still commonly used to develop a framework where instructors can integrate affective feedback in educational settings (Nelson & Schunn, 2009).

The previous investigation concerning feedback types has established a foundational understanding of cognitive feedback in terms of how and when it is delivered (Koedinger et al., 1997). Tan and Biswas used an intelligent tutoring system, namely Betty's Brain, to find out which type of feedback is more effective. The findings show that metacognitive feedback has a more positive impact on learning outcomes than corrective feedback (Tan & Biswas, 2006). Furthermore, research concludes that cognitive feedback promotes achievement for learners compared to affective feedback (Boyer et al., 2008).

In Table 2, Arguedas and Daradoumis (2021) conceptualization of affective and cognitive feedback types to determine what type of feedback is more effective on learner motivation.

Table 2. Features of cognitive and affective feedback (Arguedas and Daradoumis, 2021 p.1172)

Cognitive Feedback	Affective feedback
Encourage student's proposals and initiatives	Do not hinder students' creative process
Inform students about what they are going to learn	Create an appropriate emotional climate
Inform students about the purpose of the activity	Foster an environment that encourages creativity

Bring students to real-world tasks and achieve that they express in a clear way the previous knowledge	Provide students confidence in carrying out the activity
Arouse student's interest in topics/contents to be addressed	Motivate students to think that lesson goals are achievable
Prompt cues about the target response	Motivate students to get involved
Ask questions to help the students for improving cognitive schema	Inform students that they are on track

2.5. Impact of Feedback on Intrinsic Motivation

Intrinsic motivation is elucidated as performing actions for inner reasons(Ryan & Deci, 2000). Conversely, extrinsic motivation occurs when separable outcomes are the main trigger of behaviors (Ryan & Deci, 2000). Intrinsic motivation is associated with inner activation occurring within individuals, furthermore, the relationship between individuals and activities is another variable since personal preferences might affect which activities participants will incline for and it might not be reasonable to expect that everyone is motivated jointly for any task (Ryan & Deci, 2000). Performance-related feedback is an important part of effortful learning, as information about correct responses and errors can motivate learners to adapt their behaviors (Carreira, 2011; DePasque & Tricomi, 2015). Moreover, findings of a study conducted by DePasque & Tricomi (2015) posits that intrinsic motivation is an important factor to maintain the instructive efficacy of feedback over time and strengthen the relationship between neural processing during learning and the subsequent ability to use this information when it is needed. Carreira (2011) points out in his study that students who enjoy schoolwork are likely to have higher intrinsic motivation for learning a foreign language and higher interest in foreign countries. Compared to students whose motivation is based on extrinsic items, students' intrinsic motivation is more likely to have superior performance in learning activities, be more determined in completing tasks, and use a deep level of thinking about different dimensions of the presented information (Ryan & Deci, 2000; Vansteenkiste et al., 2006).

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2.6. Task Persistence

According to Dumdumaya and colleagues (2018), persistence is an indicator of learning, which is not categorized as a cognitive aspect. Regarding classroom settings, persistence is demonstrated through students' participation in a task as interest and enthusiasm are observed as supporting evidence (Dumdumaya et al., 2018). Additionally, Skinner and colleagues (2008) state that engagement is a combination of behavioral and emotional dimensions, which refers to positive interactions within the educational environment. Dumdumaya and colleagues (2018) compared more persistent and less persistent groups of students and the results demonstrated that the more persistent group is distinguished in terms of help-seeking behaviour and increased level of task engagement. Data from Boe and colleagues' (2002) research points out that task persistence is a non-cognitive skill. Also, the researchers developed Student Task Persistence (STS) index to measure the perseverance of the students on a task. The study shows that there is a strong relationship between STS and the test results of the students (Boe et al., 2002).

2.7. Animated Pedagogical Agents

Animated Pedagogical Agents (APAs) have been hypothesized by researchers to improve student motivation, interest, and learning outcomes (Atkinson, 2002; Carlotto & Jaques, 2016; Johnson & Lester, 2016; Lin et al., 2020; Moreno et al., 2001). An animated pedagogical

agent is defined as a type of virtual agent that delivers instructions, gives feedback, and interacts with the learner through a verbal or non-verbal form in a computer-based learning environment (Arguedas & Daradoumis, 2021; Atkinson, 2002; Lin et al., 2020). Furthermore, Atkinson (2002) points out that APAs reside in the learning environment by appearing as animated characters, which allows them to mimic human-human interactions. Lester and colleagues (1997) state that animated agents offer a great opportunity for providing real-time suggestions since they have an appealing appearance and their behaviors which resemble real-life situations. Hence, the roles of APAs may vary in a learning environment and any educational context. For instance, while APAs could be adapted to instructions act upon the learner, not all APAs have these features (Moreno et al., 2001). The existing literature on APAs is extensive and focuses particularly on the impact of motivation and learning outcomes (Arguedas & Daradoumis, 2021; Chin et al., 2016; Grivokostopoulou et al., 2020; Horovitz & Mayer, 2021; Johnson & Lester, 2016; Lin et al., 2020; Yung & Paas, 2015). Moreno and colleagues (2001) created a microlearning environment called Design-A-Plant, in which the students receive verbal and text-based feedback and advice according to their responses. The results showed that students performed better with interactive APA with verbal feedback than text-based feedback and the group with no APA (Moreno et al., 2001).

Another study dealing with the persona effect of APAs revealed that the interaction of agents, with well-designed lifelike persona, with students in a digital learning environment, is perceived as being very helpful and entertaining (Lester et al., 1997). Lin and colleagues (2020) investigated four different conditions (agent vs no agent and conversational style vs formal style). The study highlighted major findings that APAs contributed to being interesting in the lesson and conversational style increased mental effort. Arguedas and Daradoumis (2021) examined affective and cognitive feedback delivered by an APA. The findings designate that cognitive feedback leads to motivational promotion whereas affective feedback helps to create an appropriate climate in the classroom.

Grivokostopoulou and colleagues (2020) supported similar findings stating that APAs can enhance the learning experience and engagement with the activity. In another major study, Horovitz and Mayer (2021) found that human tutor is more recognizable in terms of affective states in a video lecture although pedagogical agent and human tutor groups showed similar rating results. A recent experimental study by Detailed examination of APAs and cognitive load by Yung and Paas (2015) showed that an APA had a positive impact on learning outcomes. However, no significant evidence was found regarding cognitive load.

Significant analysis and discussion on the subject were presented by Chin and colleagues (2016) point out that courseware design with APAs has a strong connection with students' motivation and interest.

2.8. Theoretical Frameworks

The core of this study is to collect and investigate data about task persistence and perceived motivation of students when APAs are integrated into the formative assessment process. Therefore, practical, and multi-dimensional theory based on motivational instruction design in terms of result analysis is at the center of this thesis (Keller, 1983). Keller (1983) introduced a model focusing on motivation, which is called ARCS Instructional Model (an acronym for attention, relevance, confidence, and satisfaction). The attention category refers to learners' general interest or affective states such as curiosity or boredom. Relevance deals with whether learners' goals comply with the instructional outcomes. The confidence category covers the learners' beliefs on success whereas the category of satisfaction discusses the appropriate balance between intrinsic and extrinsic outcomes. Recently, Keller (2016) added another dimension to the model and revised it as ARCS-V (v is an acronym for volition). Volition refers to the commitment of the learners towards achieving the task or learning outcomes. In previous studies, the model is implemented in designing web-based courses, and foreign language learning areas (Chang & Lehman, 2002; ChanLin, 2009). However, only a limited number of research is reviewed discussing APAs and the ARCS model aiming to investigate motivation and task persistence (Chin et al., 2016).

Since this study is based on the interaction between the students and an APA, while assisting the teacher to build knowledge together, constructivism is the second major theoretical foundation. Constructivism is the theory of learning which claims that learners are active participants in the learning process rather than a passive role, in which the learners absorb information with strictly limited engagement (Vygotsky, 1978). From the social perspective, Vygotsky (1978) points out that social constructivism is rooted in the concept that learning occurs as a consequence of social interactions. Also, the history of constructivism is strongly concerned with emerging technology integration to support learning (Hof, 2021). Constructivists argue that learning takes place efficiently when the learner finds the task and context are meaningful (Veletsianos, 2016). In line with constructivism, Hattie (2008) follows the idea that interaction, which is also stated as feedback, is among the most significant determiners in maximizing learning outcomes as a result of extensive data collection over the years.

3. Methodology

An intervention is designed with the object of investigating these research questions:

1. How formative assessment (feedback) affects student performance in terms of learning outcomes?

2. How do students experience and get motivated through the process of formative assessment delivered by the APA compared to a teacher?

3. How do students' expressed motivation by the interaction with the agent is reflected in task persistence?

4. What are the opportunities and challenges a teacher could encounter when integrating APA technology in the classroom?

An experimental case study approach is adapted to scrutinize ill-structured issues in a real context. A quasi-experimental design is followed as the sample selection method is non-random because of practical and bureaucratic reasons. The participants of the study belong to three different fifth classes, and the author of this thesis teaches them English on a regular basis. For data collection, the following instruments were used: (1) pre and posttests, (2) a follow-up activity, and (3) a motivation questionnaire.

3.1. Sample

The participants of this study were upper-elementary students (5th grade, B-C-D classes). The total number comprised 31 girls and 30 boys. The three classes had a balanced gender ratio. Among the participants, 9 of the students had issues in the data collection process. Before beginning the research, permission was obtained from the school administration and the consent forms were all signed by the parents whose children voluntarily participated in the research. Participants' demographics are presented in Table 3.

Table 3. Students' demographics

	No. of Female Students who participated in all the activities	No. of Male Students who participated in all the activities	Average age
5/B (The APA)	8	11	11
5/D (The Teacher)	9	8	11
5/C (No feedback)	9	8	11

Non-probability sample method was used to select participants for this research as the study aims to analyze a specific group of students. The population of the study was chosen by convenience sampling. The reason behind the latter is that the students were already accessible for the study since the researcher is also the teacher of the participants.

3.2. Study Design

The design of the study is based on a quasi-experimental setting as the selection of the students was non-randomized. Previous research concludes that although it does not represent the population, it is useful especially when the random selection is impossible due to the reason that the researcher has strict limitations such as workforce and time (Etikan et al., 2016). Three participating classes were assigned to the following conditions: (1) feedback delivered by the APA in 5B (the APA condition), (2) feedback delivered by the teacher in 5D (the teacher condition), and (3) 5C the control group not getting any kind feedback (no feedback condition).

3.3. Technological Setting and Rehearsals

The technological setup involved two stations: local and remote. The local setup was the classroom in Turkey where the author of this thesis was the teacher in charge. The equipment used in this station comprised of a touch-screen smart board with a fiber internet connection, and a webcam with a built-in microphone to establish communication with the remote station. The remote station was in Estonia and was where the APA was controlled by a researcher. The software used to control the APA as a virtual puppet was Character from adobe. Character software allows to control the movement, synchronous gestures, and lip-sync capabilities when receiving an audio signal. The second software used was Arena by RESOLUME where the video signal of the virtual puppet was sent via Syphon protocol. In addition, Arena software allows merging layers of multimedia content and video sources. The latter capability allowed the researcher, controlling the virtual puppet, to broadcast virtual backgrounds as well as web applications used to deliver the formative feedback to the students. The remote station connected with the local station via a video-conferencing application (Zoom). This study simulated the APA system in what is known in the computer science field as a Wizard of Oz, where a real human was controlling the system, but students experienced the APA as autonomous.

Scenario and script were created for teacher and PA conditions to maintain the intervention in a similar way an APA system would perform (see Appendix 1 & 2). The

scenarios and scripts were identically created since the aim of the study is also to compare the teacher and PA giving feedback and interacting with the students.

Two rehearsals were conducted before the intervention. In the first rehearsal, both the teacher and researcher connected to test the equipment on both ends. Key elements they considered to confirm the intervention was going to be feasible included internet connection, webcam with built-in microphone quality, speakers, and the smartboard running without any technical issues.

The objective of the second rehearsal was to practice the scripts both teacher and agent needed to perform for the APA condition. The teacher practiced his role as well as probable students' responses and behaviors during the intervention. The teacher (author of this thesis) detected the errors in the Padlet assignment students did, and the researcher in the remote station used these notes to perform as the APA. In the end, both rehearsals allowed to adjust technical details before the planned intervention.

Since the interaction between the students and the APA was scripted, the number of questions was limited according to the objectives of the units and the answers were semi-structured. A copy of these semi-structured dialogue examples was handed out to the students, and it was named a question-and-answer pool to explain it to the students quickly. The reader may see in Table 4, the question-and-answer pool, which is handed out to the students to prepare for the intervention

Table 4. The question-and-answer pool for the students and the APA

What is your name?	My name is Uku
Which city are you from?	I am from the jungle.
How many languages do you speak?	I speak English.
What are your favorite school subjects?	My favorite school subjects are Mathematics and Social Studies.
What are your abilities?	I can do origami and I can climb trees
Can you play chess?	Yes, I can play chess and it is very enjoyable
Can you swim?	No, I can't swim. I am afraid of the sea.
What are your hobbies?	My hobbies are jumping and playing games with my friends.
What time do you get up?	I get up at quarter past seven o'clock in the morning.

What time do you have dinner?	I have dinner at half past six in the evening.
What do you do at weekends?	I eat bananas, I spend time with my family, and I meet with my friends in the jungle.
I have a headache. What should I do?	You should take a painkiller.
I have a toothache. What should I do?	You should see a dentist.
I have backache. What should I do?	You shouldn't carry heavy things.
Please give me three different directions.	Turn left/Turn right/Go straight ahead

3.4. The Intervention

Before the intervention, the students completed a pre-test, which consists of 20 multiple choice questions aiming to assess various objectives from the five units in the first term (see Appendix 3). The goal of the pre-test was to obtain data about the students' current level of achievement.

After the pre-test was completed, the students were assigned a task on Padlet. The task began with clicking on the Padlet link sent both on the WhatsApp class group and a learning management application called EBA. The first task was to add a picture of any favorite place or public building. Next, the following questions were needed to be answered:

1. What are your favorite classes?
2. What are your hobbies?
3. What do you do after school? (at least 3 sentences)
4. Name an illness and make one suggestion for recovery.

The allowed period for this task was five days. The procedural information on how to use Padlet was provided by the teacher during the lesson. Furthermore, an explanatory video was recorded and posted to avoid any confusion for the students who were absent on that day. It was possible to ask any questions to the teacher onsite or online during the five days for clarification.

On the intervention day, the teacher set up the webcam on the smartboard and made a quick test with the researcher controlling the APA ten minutes before the intervention started. After making sure that everything was ready and running smoothly, the intervention started with the teacher introducing the APA, and formative feedback was delivered by the APA individually for 7 students in approximately 16 minutes. The teacher's primary role was as a facilitator for the activity. When the student could not understand or answer the questions, the teacher interfered to make quick clarification in addition to guiding the APA on what to do next.

Figure 1. A moment from the intervention with the APA collaborating with the teacher

Overall, the intervention with APA went without any major issues and the planned script was followed as planned. However, on a few occasions, the teacher needed to ask students and/or the APA to speak again as the audio was not clear in one of the two stations. After the formative assessment was delivered by the APA, the teacher asked the students to complete the follow-up activity, which included five questions covering the objectives from the five units (see Appendix 4). The objectives of the activity were similar in both the Padlet assignment, and the follow-up activity. The difference between the Padlet and the follow-up activity was that in the latter, the students completed the task in the classroom and on paper. The time allocated for the follow-up activity was 10 minutes. After the follow-up activity, a motivation questionnaire consisting of six questions on a 5 Likert scale was handed out to the students to fill in (see Appendix 5). 5 minutes were allowed for completion of the questionnaire.

The pre-determined identical scenario was followed in 5D (teacher condition) on the same day. The teacher gave feedback on the Padlet task using the smartboard and using the identical language with the APA in approximately 16 minutes for 7 students as in APA condition. The same follow-up activity is completed in 10 minutes by the students. Also, an identical motivation questionnaire was filled in by the students as in the APA condition (see Appendix 6).

5C (no feedback group) completed the same follow-up activity the next day. The motivation questionnaire and drawing activity were not applied to this group because they had no experience with any agent and feedback.

A post-test consisting of 20 multiple choice questions was distributed to all the groups and the students were expected to solve the test in twenty minutes (see Appendix 7). The questions were different from the pre-test. However, the objectives and the units remained the same. The post-test aimed to review any positive or negative change in terms of achieving the objectives.

In addition to the pre and post-tests, a motivation questionnaire was adapted from Galuccio and Gustavo's (2008) study. Two identical questionnaires were formed. Both questionnaires consist of six questions, which are presented in Turkish because the students' English language proficiency was at the beginner level. While the questionnaire prepared for the APA condition group asked to evaluate the APA, the teacher group was asked to evaluate their teachers' performance affecting their motivation. The names are required for the questionnaire from the APA condition group (5B), and it is considered that there is no meaningful reason influencing their answers because they evaluated the APA, not the teacher. The questionnaire for the teacher group (5D) remained anonymous because students might think that the answers could influence their teacher's opinions about them. Furthermore, while the teacher group was answering the questionnaire, the teacher turned his face and assured that he was not looking, and that could not affect anything about the English lesson in general. The theoretical background behind the questionnaire is Keller's (1983) ARCS (Attention, Relevance, Confidence, and Satisfaction) model. For the instrument validation, the instrument was examined by two viewers who provide their impressions and approval of how well each question addressed the components of the ARCS model in Galuccio and Gustavo's (2008) study. The first question of the instrument addressed the Attention constituent of the ARCS model. The first item evaluated whether the student thought the agent (the APA or the teacher) helped maintain his/her attention. The second question aims at the Relevance component of the ARCS model. The second item evaluated whether the animated agent made the student feel the activity was relevant to the English class. The third question is strongly related to the Confidence component of the ARCS model. The third item evaluated whether the agent (the APA or the teacher) collaborating with the teacher made the student feel confident about him/herself. The fourth section addressed the Satisfaction component of the ARCS model. The fourth item evaluated whether the agent (the APA or the teacher) made the

student feel satisfied with his/her performance in that activity. The fifth question asks whether the student would like to have another lesson with the agent (the APA or the teacher) again in the future. The sixth question aimed to inquire whether the students were generally motivated during the intervention with the agent (the APA or the teacher). All the questionnaire items were measured with 5 levels Likert scale. All Likert scales in these questionnaire items ranged from "No, not at all" (coded as 1) to "Yes, a lot" (coded as 5). 55 students responded to the questionnaire.

In addition to pre-post tests and the motivation questionnaire, a follow-up activity was conducted right after the agents (the APA and the teacher) delivered feedback. The follow-up activity was based on a worksheet that consists of five questions to answer. The objectives for each question for the follow-up activity are presented in Table 5:

Table 5: Follow-up activity questions matching the objectives and units of the lesson

Target Objectives	Units	Questions/Tasks
Students will be able to talk about the locations of things and people in simple conversations.	#2 My town	Pick one public building from the picture above and locate it
Students will be able to give information about likes simply.	#3 Games and hobbies	What do you like doing in your free time?
Students will be able to read and understand the timetable for their lessons.	#1 Hello	Which classes do you have on a typical weekday (It can be any weekday)?
Students will be able to understand the time.	#4 My daily routine	What time is it now?
Students will be able to understand simple suggestions concerning illnesses.	#5 Health	Imagine that one of your friends has the flu. Please give some advice to him/her.

Obtaining qualitative data procedure followed by the teacher's observations during all the activities applied in the classroom led to what was the overall reactions and the atmosphere of the learning environment for the experiment beyond the numbers.

3.5. Data Analysis

For quantitative data analysis, SPSS software was used to run the following statistical analysis: (1) descriptive statistics, to compare means among the three conditions to evaluate learning outcomes attributed to formative assessment (pre posttest comparison); (2) a T-test analysis on the motivation questionnaire answered by the APA and the teacher condition to find out if no statistical difference supported the hypothesis that students perceive the AP

similarly to the teacher; (3) Pearson correlation analysis to understand if expressed motivation in both conditions had a direct relation with task persistence (effort) on the follow up activity done after the delivery of formative assessment feedback.

For the qualitative aspect of the study, the author of this thesis carried out a content analysis of the notes took during the intervention. The data was sorted among meaningful categories presented in the next section.

4. Results

RQ1. How formative assessment (feedback) affects student performance in terms of learning outcomes?

Among the interest of this study, was to confirm whether formative feedback had a positive impact on students' learning as the literature suggests. To answer this question, we analyzed the pretest and posttest results of all conditions. Figures 1, 2, and 3, present all conditions descriptive statistics. Regarding students' performance in terms of learning outcomes, there was no statistically significant change for any of the conditions. Thus, no direct impact was able to be attributed to the formative assessment process of delivering feedback in this regard. From the pretest and posttest results, we can observe that in the teacher condition, the difference between the pretest and posttest was bigger 18% compared to the APA condition 3%, and the control condition 6%. Furthermore, it can be observed that all three conditions were not homogeneous as their pretest mean results varied drastically from control, teacher, and APA condition (64.21, 55.26, and 82 respectively). However, in the teacher condition, students paired closely with their posttest results with the control condition.

Table 6. Control group

	N	Minimum	Maximum	Mean	Std. deviation
Pre-test	19	30	90	64.2	19.5
Follow-up	19	0	75	47.4	21.4
Post-test	20	30	95	68.5	19.7
Motivation	0				

Table 2. Teacher condition

	N	Minimum	Maximum	Mean	Std. deviation
Pre-test	19	20	95	55.3	17.5
Follow-up	19	0	90	32.4	26.7
Post-test	19	0	100	67.4	21.5
Motivation	18	37	100	88.3	16.3

Table 7. Animated Pedagogical Agent Condition

	N	Minimum	Maximum	Mean	Std. deviation
Pre-test	20	40	100	82	16.0
Follow-up	20	0	100	69.8	24.0
Post-test	20	55	100	84.8	12.8
Motivation	20	0	97	78.7	21.0

RQ 2. How do students' expressed motivation when receiving formative assessment is reflected in task persistence when engaging in follow-up activities?

In order to answer this question, results from the questionnaire targeting students' motivation were analyzed and compared between APA and teacher conditions (77.41. and 88.3 respectively). The T-test analysis showed no statistical difference between the two conditions. (Figure 4). This result suggests students perceived the APA to be able to deliver formative assessment feedback processes similarly to how the teacher did.

Table 4. Motivational questionnaire results

	N	Mean	Std. deviation
Motivation PA	18	77.4	21.8
Motivation T	18	88.3	16.3

RQ 3. How do students' expressed motivation when receiving formative assessment is reflected in task persistence when engaging in follow-up activities?

One of the hypotheses of this work was that expressed students' motivation will correlate to task persistence (effort) on a follow-up activity right after the formative assessment was delivered. In this case, the results obtained with Pearson Correlation analysis showed no correlation in any of the experimental conditions (Figure 5). Thus, the current analysis cannot confirm whether expressed motivation of the students can be transferred to learning activities, and if APAs are able to motivate students in their learning process as the literature suggests.

Table 8. Correlation between students' expressed motivation and follow up activity.

	Maximum	**Motivation**	**Follow-up**
Motivation	Pearson correlation	1	.167
	Sig. (2-tailed)		.315
	N	38	38
Follow up Act.	Pearson correlation	.167	1
	Sig. (2-tailed)	.315	
	N	38	59

RQ 4. What are the opportunities and challenges a teacher could encounter when integrating APA technology in the classroom?

To answer this question, the author of the thesis, in the role of a teacher, kept notes of his observations, impressions, and concerns. This qualitative exercise helped to better understand and linked to the questions approached from a quantitative perspective.

Observations: The curiosity of the students was significantly noticeable. Many questions were raised about the APA and the interaction, which was unusual compared to introducing other applications in the classroom. The APA succeeded to draw students' attention. However, two of the students expressed that they were reluctant to get feedback from the APA since they did not personally know it. Also, some of the students underperformed while interacting with the APA and they expressed that they were excited because the APA was a foreigner in their opinion. When the APA was inviting the students by calling their names individually, the atmosphere of the classroom was positively enhanced as students did not expect the agent to know them. The students' reactions to the gestures of the APA such as smiling, walking, and eating were also positive. The students started to make comments about what the APA was doing, and it can be regarded as a sign of enchantment. When the intervention ended, the most frequently asked question was whether the APA would be in the classroom again. This shows that most of the students would like to have the following lessons with the APA.

Impressions: The APA as a co-instructor provided an opportunity for the teacher to observe the classroom more elaborately. Nearly all the students' current emotional state and their reactions were observed since the focus of the student were on the APA. Using an APA as a co-instructor have the potential to alleviate some orchestration load, allowing the teacher to observe students' reactions and detect students that might need extra help. For instance,

while the fast learners interact with the APA, the slow learners might have a chance to get more detailed feedback from the teacher. Furthermore, the APA can be used for various purposes in teaching foreign language teaching. For instance, the APA can assist the teacher in speaking lessons, or listening activities might be completed with the assistance of the APA.

   Concerns: Although integrating the APA in the classroom generally left positive impressions, from a teacher point of view, the time spent creating the scenario and the script was excessive. The latter raised some doubt on how the APA could be a co-instructor in the classroom frequently and practically. This issue might be overcome through different perspectives by creating a framework for classroom flow or artificial intelligence techniques embedded into the system for ease of use. Moreover, the intervention had interconnected requirements such as operating devices, collaboration with the controller of the APA, and specific devices in addition to a stable internet connection. Every requirement had a significant impact on conducting the intervention and the intervention would be canceled when one requirement was not met. The researcher, who is controlling the APA, was not in the field of foreign language teaching. It might have affected the type and effectiveness of the feedback. To extend this intervention to regular practice, the responses of the APA could be more autonomous, and controlled by programmed software with the help of other disciplines.

5. Discussion

This study aimed to answer four questions: (1) How does formative assessment (feedback) affects student performance in terms of learning outcomes? (2) How do students experience and get motivated through the process of formative assessment delivered by the APA compared to a teacher? (3) How do students' expressed motivation by the interaction with the agent is reflected in task persistence? (4) What are the opportunities and challenges a teacher could encounter when integrating APA technology in the classroom?

The results of the pretests and posttests indicate that there was no direct relation between students' learning outcomes and the delivering of formative assessment, not by the APA nor the teacher. Prior research suggest that animated agents offer a great opportunity for providing real-time suggestions since they have an appealing appearance and their behaviors which resemble real-life situations (Lester et al., 1997). The results did not support the hypothesis that the latter benefits could be materialized in learning outcomes. Moreover, the difference between the APA condition (%3 percent) and the teacher condition (18%), suggests the APA system was not as effective as the teacher to influence students' performance in the posttest. It is important to bare in mind that the avarage pretest scores in all conditions were not comparable, and further studies with larger sample is needed to ground this preliminary findings. Notwithstanding the latter analysis, an increase in the posttest was observed in all conditions (although not statistically significant), which do not contradicts previous findings. For instance, Carreira (2011) and DePasque and Tricomi's work (2015) that points out that performance-related feedback has a significant component of learning in addition to Gedye's (2010) statement on formative assessment improving learning and performance. One posible explanation for the teacher condition to outperform APA and control condition, could be attributed to additional explanations during the intervention. This is clearly a challenge for APA systems' development as teachers organically use different strategies for feedback based on unexpected situations (Nelson and Schunn, 2009).

Noteworthy, students'motivation questionnaire answers, did not showed statistical significant difference between APA and teacher condition. This shows that the APA has similar effect on motivation compared to the teacher in the context of this study. Since the scenario requires the APA to give affective feedback as the teacher normally do in the lesson, it might be one of the main reasons for this results. It is also in line with findings by Arguedas and Daradoumis (2021) concluding that affective feedback enables desired classroom climate. Further studies are needed to better understand students' motivation (Ryan and Deci, 2000), to

identify the intrinsic reasons that could be elicit by the APA giving feedback in comparison to the teacher.

No correlation between the two experimental conditions could be devised between task persistence (effort), and the follow-up activity. This contradicts the findings of Dumdumaya and colleagues (2018) advocating that APAs can influence students' task persistence. However, the results showed that the APA does not have negative impact on students' task persistence to complete a task. This might be regarded as an indicator that from the educational technological stand, APA systems potentially could be deployed without hindering students' task persistence (effort).

From teachers' observations, some considerations to integrate APA technology in the classroom were identified: Firstly, the APA can be used as an opportunity for teahcers to aleviate classroom orchestration load. Secondly, regular usage of the APA could be limited due to practical constrains (i.e equipment expertice, internet conection, technical equipment cost).

5.1. Conclusions

This study was intended to investigate two objectives: (1) examining the potential benefits of APAs to be used by teachers in their practice, and (2) exploring how APA-driven feedback could support students' motivation reflected in task persistence compared to teacher-driven feedback. To examine the potential benefits of APAs, a quasi-experimental design was followed with three 5th grade classes (n=61). The author of the thesis was also the teacher. Three experimental setting consisted of three conditions: APA-driven feedback, teacher feedback, and control group. Our results to examine the impact of the feedback on learning performance and task persistence (effort).

The results of the follow-up activity indicated that there was no significant correlation between task persistence and the source of the feedback, thus, this study was note able to attribute further motivational links beyond the synchronous interaction between the students' and the APA. The motivation questionnaire was also applied for the APA and the teacher conditions to explore students' perceived motivation. The result of the questionnaire is in line with the results obtained from the follow-up activity. However, no statistical difference was found between APA and teacher condition, suggesting that APA has the potential to be similarly perceived as the teacher.

Based on the teacher observations, integrating an APA in teaching practices provides opportunities along with challenges. The APA-driven feedback at classroom level can bring

excitement and curiosity as the APA is perceived a life-like character as a guest for the lesson by confirming Lin and colleagues' study (2020). Although the quantitative data points out that the teacher condition has increased their performance at the end of the intervention, it cannot be deducted whether the APA has impact on students' performance or learning outcomes. The limitation of sampling method was supported by teacher's insights. Overall, for languages domains, it can be concluded that potential usage of the APA might include improving speaking skills, differentiating the tasks, and alleviating some orchestration load for the teacher.

5.2. Limitations and Further Research

The population of the study was limited to 61 5th grade students studying in a public upper-elementary school in Turkey and sampling is based on convenience due to the time and job restrictions. Therefore, generalizing these results to other 5th grade students would require bigger sample and randomize assignment to experimental conditions. On the technical aspects, the APA was controlled by a researcher and the system needed to be controlled with high technical skills, which most likely won't be practical to implement in school settings. Technical restrictions could be overcome with the development of technology such as artificial intelligence for feedback. Also, the scenario and script of the intervention are limited to pre-determined dialogues. The controller of the APA is limited to one researcher so how the background of the APA controller could affect the experience is limited to only one person. In the classroom setting, the interaction between the APA and the students is limited to the smartboard, which limits the study in terms of devices used during the intervention. Regarding this thesis, more detailed research integrating the APA regularly for a longer period should be covered to investigate students' profiles and preferences.

Based on the intervention some recommendations and constraints to consider were devised: the APA technology needs to be semi-autonomous and programmed by a computer or a system meaning the reactions and the feedback should be adjustable by the instructor without the need of another educator on the remote setting, like in this case. Secondly, the requirements of technological devices limit the integration of the APA in the schools where it lacks a stable internet connection and devices. This intervention could be considered as one of the early studies to use APA systems at a classroom setting to empower teachers' practice and facilitate students' learning.

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Author's Declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.

Signature: Date: 03/06/2022

7. List of References

Antoniou, P., & James, M. (2014). Exploring formative assessment in primary school classrooms: Developing a framework of actions and strategies. *Educational Assessment, Evaluation and Accountability,* 26(2), 153–176. https://doi.org/10.1007/s11092-013-9188-4

Arguedas, M., & Daradoumis, T. (2021). Analysing the role of a pedagogical agent in psychological and cognitive preparatory activities. *Journal of Computer Assisted Learning*, 37(4), 1167–1180. https://doi.org/10.1111/jcal.12556

Atkinson, R. K. (2002). Optimizing learning from examples using animated pedagogical agents. *Journal of Educational Psychology*, 94(2), 416–427. https://doi.org/10.1037/0022-0663.94.2.416

Boe, E. E., May, H., & Boruch, R. (2002). Student Task Persistence in the Third International Mathematics and Science Study: A Major Source of Achievement Differences at the National, Classroom, and Student Levels. *CRESP Research Report*. https://repository.upenn.edu/gse_pubs/412

Boud, D., Dawson, P., Bearman, M., Bennett, S., Joughin, G., & Molloy, E. (2018). Reframing assessment research: through a practice perspective. *Studies in Higher Education*, 43(7), 1107–1118. https://doi.org/10.1080/03075079.2016.1202913

Boyer, K. E., Phillips, R., Wallis, M., Vouk, M., & Lester, J. (2008). Balancing cognitive and motivational scaffolding in tutorial dialogue. In *LNCS* (Vol. 5091).

Bruning, R. (2001). *Providing Feedback in Computer-based Instruction: What the Research Tells Us*. https://www.researchgate.net/publication/247291218

Carlotto, T., & Jaques, P. A. (2016). The effects of animated pedagogical agents in an English-as-a-foreign-language learning environment. *International Journal of Human Computer Studies*, 95, 15–26. https://doi.org/10.1016/j.ijhcs.2016.06.001

Carreira, J. M. (2011). Relationship between motivation for learning EFL and intrinsic motivation for learning in general among Japanese elementary school students. *System*, 39(1), 90–102. https://doi.org/10.1016/j.system.2011.01.009

Cauley, K. M., & McMillan, J. H. (2010). Formative Assessment Techniques to Support Student Motivation and Achievement. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(1), 1–6. https://doi.org/10.1080/00098650903267784

Chaffar, S., & Frasson, C. (2004). Using an Emotional Intelligent Agent to Improve the Learner's Performance. *Proceedings of the Workshop on Social and Emotional Intelligence in Learning Environments in Conjunction with Intelligent Tutoring Systems*.

Chang, M.-M., & Lehman, J. D. (2002). Learning Foreign Language through an Interactive Multimedia Program: An Experimental Study on the Effects of the Relevance Component of the ARCS Model. In *Number 1 CALICO Journal* (Vol. 20, Issue 1).

ChanLin, L. J. (2009). Applying motivational analysis in a Web-based course. *Innovations in Education and Teaching International*, *46*(1), 91–103. https://doi.org/10.1080/14703290802646123

Chin, K. Y., Hong, Z. W., Huang, Y. M., Shen, W. W., & Lin, J. M. (2016). Courseware development with animated pedagogical agents in learning system to improve learning motivation. *Interactive Learning Environments*, *24*(3), 360–381. https://doi.org/10.1080/10494820.2013.851089

Cunha, J., Rosário, P., Núñez, J. C., Vallejo, G., Martins, J., & Högemann, J. (2019). Does teacher homework feedback matter to 6th graders' school engagement?: a mixed methods study. *Metacognition and Learning*, *14*(2), 89–129. https://doi.org/10.1007/s11409-019-09200-z

Daly, C., Pachler, N., Mor, Y., & Mellar, H. (2010). Exploring formative e-assessment: Using case stories and design patterns. Assessment and Evaluation in Higher Education, 35(5), 619–636. https://doi.org/10.1080/02602931003650052

DePasque, S., & Tricomi, E. (2015). Effects of intrinsic motivation on feedback processing during learning. *NeuroImage*, *119*, 175–186. https://doi.org/10.1016/j.neuroimage.2015.06.046

Dillenbourg, P., & Jermann, P. (2010). Technology for classroom orchestration. In New science of learning (pp. 525-552). Springer, New York, NY.

Dumdumaya, C. E., Banawan, M. P., & Rodrigo, M. M. T. (2018). Identifying students' persistence profiles in problem solving task. *UMAP 2018 - Adjunct Publication of the 26th Conference on User Modeling, Adaptation and Personalization*, 281–286. https://doi.org/10.1145/3213586.3225237

Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), 1. https://doi.org/10.11648/j.ajtas.20160501.11

Forbes-Riley, K., & Litman, D. (2007). Investigating Human Tutor Responses to Student Uncertainty for Adaptive System Development. *Conference on Affective Computing and Intelligent Interactions*.

Galluccio, P., & Gustavo, R. (2008). Animated Pedagogical Agents as Spanish Language Instructors: Effect of Accent, Appearance, and Type of Activity on Student Performance, Motivation, and Perception of Agent. [Doctoral thesis, Florida State University]

Gedye, S. (2010). Formative assessment and feedback: a review. *Planet*, *23*(1), 40–45. https://doi.org/10.11120/plan.2010.00230040

Goldin, I., Narciss, S., Foltz, P., & Bauer, M. (2017). New Directions in Formative Feedback in Interactive Learning Environments. *International Journal of Artificial Intelligence in Education*, *27*(3), 385–392. https://doi.org/10.1007/s40593-016-0135-7

Grivokostopoulou, F., Kovas, K., & Perikos, I. (2020). The effectiveness of embodied pedagogical agents and their impact on students learning in virtual worlds. *Applied Sciences (Switzerland)*, *10*(5). https://doi.org/10.3390/app10051739

Hattie, J. (2008). Visible learning: A synthesis of over 800 meta-analyses relating to achievement. In *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. https://doi.org/10.4324/9780203887332

Havnes, A., Smith, K., Dysthe, O., & Ludvigsen, K. (2012). Formative assessment and feedback: Making learning visible. *Studies in Educational Evaluation*, *38*(1), 21–27. https://doi.org/10.1016/j.stueduc.2012.04.001

Hof, B. (2021). The turtle and the mouse: how constructivist learning theory shaped artificial intelligence and educational technology in the 1960s. *History of Education*, *50*(1), 93–111. https://doi.org/10.1080/0046760X.2020.1826053

Högemann, J., Cunha, J., Núñez, J. C., Vallejo, G., Rodríguez, C., & Rosário, P. (2021). Writing intervention with elementary students struggling with writing: examining approach profiles to the teacher feedback on writing quality and motivational variables. *Reading and Writing*, *34*(7), 1681–1710. https://doi.org/10.1007/s11145-021-10159-0

Hong, Z. W., Chen, Y. L., & Lan, C. H. (2014). A courseware to script animated pedagogical agents in instructional material for elementary students in English education. *Computer Assisted Language Learning*, *27*(5), 379–394. https://doi.org/10.1080/09588221.2012.733712

Horovitz, T., & Mayer, R. E. (2021). Learning with human and virtual instructors who display happy or bored emotions in video lectures. *Computers in Human Behavior*, *119*. https://doi.org/10.1016/j.chb.2021.106724

Johnson, W. L., & Lester, J. C. (2016). Face-to-Face Interaction with Pedagogical Agents, Twenty Years Later. *International Journal of Artificial Intelligence in Education*, *26*(1), 25–36. https://doi.org/10.1007/s40593-015-0065-9

Johnson, W. L., Rickel, J. W., & Lester, J. C. (2000). Animated Pedagogical Agents: Face-to-Face Interaction in Interactive Learning Environments. In *International Journal of Artificial Intelligence in Education* (Vol. 11).

Karaman, P., Demirci, İ., & Özdemir, A. (2019). Modeling the Relationship between Motivation, Learning Approach, and Academic Achievement of Middle School Students in Turkey. *International Journal of Progressive Education*, *15*(4), 187–199. https://doi.org/10.29329/ijpe.2019.203.14

Keller, J. (1983). Motivational design of instruction. In *Instructional -design theories and models*.

Kim, Y., & Baylor, A. L. (2016). Research-Based Design of Pedagogical Agent Roles: A Review, Progress, and Recommendations. *International Journal of Artificial Intelligence in Education*, *26*(1), 160–169. https://doi.org/10.1007/s40593-015-0055-y

Koedinger, K. R., Anderson, J. R., Hadley, W. H., & Mark, M. A. (1997). Intelligent Tutoring Goes To School in the Big City. In *International Journal of Artificial Intelligence in Education* (Issue 8). https://telearn.archives-ouvertes.fr/hal-00197383

Leenknecht, M., Wijnia, L., Köhlen, M., Fryer, L., Rikers, R., & Loyens, S. (2021). Formative assessment as practice: the role of students' motivation. *Assessment and*

Evaluation in Higher Education, *46*(2), 236–255. https://doi.org/10.1080/02602938.2020.1765228

Leighton, J. P., & Bustos Gómez, M. C. (2018). A pedagogical alliance for trust, wellbeing and the identification of errors for learning and formative assessment. *Educational Psychology*, *38*(3), 381–406. https://doi.org/10.1080/01443410.2017.1390073

Lester, J. C., Converse, S. A., Kahler, S. E., Todd Barlow, S., Stone, B. A., & Bhogal, R. S. (1997). *The Persona Effect: Affective Impact of Animated Pedagogical Agents*.

Lin, L., Ginns, P., Wang, T., & Zhang, P. (2020). Using a pedagogical agent to deliver conversational style instruction: What benefits can you obtain? *Computers and Education*, *143*. https://doi.org/10.1016/j.compedu.2019.103658

Máñez, I., Vidal-Abarca, E., Kendeou, P., & Martínez, T. (2019). How do students process complex formative feedback in question-answering tasks? A think-aloud study. *Metacognition and Learning*, *14*(1), 65–87. https://doi.org/10.1007/s11409-019-09192-w

Moreno, R., Mayer, R. E., Spires, H. A., & Lester, J. C. (2001). The case for social agency in computer-based teaching: Do students learn more deeply when they interact with animated pedagogical agents? *Cognition and Instruction*, *19*(2), 177–213. https://doi.org/10.1207/S1532690XCI1902_02

Narciss, S. (2004). The impact of informative tutoring feedback and self-efficacy on motivation and achievement in concept learning. Experimental Psychology, 51(3), 214–228. https://doi.org/10.1027/1618-3169.51.3.214

Narciss, S. (2008). *Feedback Strategies for Interactive Learning Tasks*. https://www.researchgate.net/publication/233833269

Nelson, M. M., & Schunn, C. D. (2009). The nature of feedback: How different types of peer feedback affect writing performance. *Instructional Science*, *37*(4), 375–401. https://doi.org/10.1007/s11251-008-9053-x

Otsuka, J. L., Rocha, H. V., & Beder, D. M. (2007). *A Multi-Agent Formative Assessment Support Model for Learning Management Systems*. IEEE Computer Society.

Peng, T. H., & Wang, T. H. (2021). Developing an Analysis Framework for Studies on Pedagogical Agent in an e-Learning Environment. *Journal of Educational Computing Research*. https://doi.org/10.1177/07356331211041701

Pryor, J., & Crossouard, B. (2008). A socio-cultural theorisation of formative assessment. *Oxford Review of Education*, *34*(1), 1–20. https://doi.org/10.1080/03054980701476386

Roldan Roa, E.; Raave, D.K.; Chounta, I.A.; Pedaste, M. (2022). What Teachers Would Expect from a Pedagogical Agent System Working at a Classroom Level: A Focus Group Study. In European Conference on Technology Enhanced Learning. (submitted, under revision)

Roa, E. R., Chounta, I.-A., & Pedaste, M. (2021). *Towards Using Pedagogical Agents to Orchestrate Collaborative Learning Activities Combining Music and Mathematics in K-* In European Conference on Technology Enhanced Learning.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology*, *25*(1), 54–67. https://doi.org/10.1006/ceps.1999.1020

Sadler, D. R. (1989). Formative assessment and the design of instructional systems. In *Instructional Science* (Vol. 18).

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, *78*(1), 153–189. https://doi.org/10.3102/0034654307313795

Tan, J., & Biswas, G. (2006). The role of feedback in preparation for future learning: A case study in learning by teaching environments. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *4053 LNCS*, 370–381. https://doi.org/10.1007/11774303_37

Vansteenkiste, M., Lens, W., & Deci, E. L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychologist*, *41*(1), 19–31. https://doi.org/10.1207/s15326985ep4101_4

Veletsianos, G. (2016). Emergence and Innovation in Digital Learning: Foundations and Applications. In *Emergence and Innovation in Digital Learning: Foundations and Applications*. Athabasca University Press. https://doi.org/10.15215/aupress/9781771991490.01

Vygotsky, L. S. (1978). Mind and Society: The Development of Higher Psychological Processes. In *Harvard University Press*.

Winstone, N. E., Nash, R. A., Parker, M., & Rowntree, J. (2017). Supporting Learners' Agentic Engagement With Feedback: A Systematic Review and a Taxonomy of Recipience Processes. In *Educational Psychologist* (Vol. 52, Issue 1, pp. 17–37). Routledge. https://doi.org/10.1080/00461520.2016.1207538

Yacef, K. (2002). Intelligent teaching assistant systems. In ICCE 2002, 136-140. IEEE

Yung, H. I., & Paas, F. (2015). International Forum of Educational Technology & Society Effects of Cueing by a Pedagogical Agent in an Instructional Animation: A Cognitive Load Approach. *Source: Journal of Educational Technology & Society*, *18*(3), 153–160. https://doi.org/10.2307/jeductechsoci.18.3.153

Zhan, Y., & So, W. W. M. (2017). Views and practices from the chalkface: development of a formative assessment multimedia learning environment. Technology, Pedagogy and Education, 26(4), 501–515. https://doi.org/10.1080/1475939X.2017.1345783

8. Appendices

Appendix 1. The Animated Pedagogical Agent's Scenario

#No	Situation	Uku's script	Pedagogical move	Subcategory	Feedback Type	Feedback Status
1	The teacher introduces Uku to the class.	Hello, my name is Uku. I live in Tartu, and I like bananas.	Establish a bound	Getting acquainted	Introductory script	Affective
2	The teacher asks Uku to invite one student to the board.	Okay, let me see. Dear …... could you come here?	Maintaining instructions	Getting ready for interaction	Directive script	Affective
3	Uku scans the photo added by the student and asks	Where is this place?	Knowledge check	Knowledge of outcome	Response contingent	Cognitive
4	If the student answers the "Where is this place?" question correctly.	Nice, you are doing well.	Maintaining motivation	Appraisal of the achieved objective of the lesson	Motivational	Affective
5	If the student can't answer or the answer is incorrect	No, I think this place is…… [says what Uku identifies in the picture] Could you repeat after me please? [This place is….]	Repeat-until-correct	Informing the learner about an incorrect response	Try again	Cognitive
6	Uku scans the text that belongs to the student who is standing in front of the board. If the answers have some errors	Hmm… I see a little mistake in your answers. *To correct syntax errors:* [Repeats the wrong sentence to make the student realize the mistake/s] *To correct spelling errors:* [Spells the correct form of the word]	Repeat-until-correct	Informing the learner about an incorrect response	Try again	Cognitive
7	If the student	Well done. You did a great job	Maintaining motivation	Appraisal of the achieved	Motivational	Affective

	corrects the mistake at this point			objective of the lesson		
8	If the student has difficulties in finding the correct response	It's okay. Please have a look at your answer again. You can do it!	Maintaining subjective well-being	Emotional support	Emotional	Affective
9	When the student cannot realize his/her mistake	Let me help you, please repeat after me [Uku provides the correct response]	Providing correct answer	Knowledge of correct response	Correct response	Cognitive
10	If the student corrects the mistake at this point	Great. Congratulations	Maintaining motivation	Appraisal of the achieved objective of the lesson	Motivational	Affective
11	When the student still cannot reach the correct answer	Süleyman Teacher, could you help me? [The instructor takes the lead]	Prompting	Asking for help from the instructor	Directive script	Cognitive
12	Uku scans the text that belongs to the student who is standing in front of the board. If the answers are correct	Exactly right. You are very good at that.	Informing the student and maintaining motivation	Highlighting the achievement and appraisal	Verification	Both Cognitive and Affective
	After giving feedback to the students,					
13	Uku invites the student, who is standing in front of the board, to ask two questions from the question-and-answer pool	Well, do you have any questions for me?	Maintaining instructions	Getting the student involved in the conversation	Directive script	Affective
14	The student asks two questions from the pool	[Uku gives pre-determined answers according to questions]	Maintaining interaction	Getting the student involved in the conversation	Conversational script	Affective

15	When the student asks Uku to repeat the response	[Uku repeats previous response]	Clarification	Making sure that students understand the response	Conversational script	Affective
16	The teacher asks Uku to invite another student to the board.	Dear …... could you come here?	Maintaining instructions	Getting ready for interaction	Directive script	Affective
	The cycle starts from the beginning again					

Appendix 2. The teacher's scenario

#No	Situation	Teacher's script	Pedagogical move	Subcategory	Feedback Type	Feedback Status
1	The teacher opens the digital board page and gives prior knowledge about the feedback process.	Now, I am going to give each of your work feedback. Please listen carefully if you have any errors in your task.	Giving Instructions	Getting ready for feedback	Introductory script	Cognitive
2	The teacher invites one random student to the board.	Dear…. could you come here?	Maintaining instructions	Getting ready for interaction	Directive script	Affective
3	The teacher scans the photo added by the student and asks	Where is this place?	Knowledge check	Knowledge of outcome	Response contingent	Cognitive
4	If the student answers the "Where is this place?" question correctly.	Nice, you are doing well.	Maintaining motivation	Appraisal of the achieved objective of the lesson	Motivational	Affective
5	If the student can't answer or the answer is incorrect	No, I think this place is…… [says what Uku identifies in the picture] Could you repeat after me please? [This place is….]	Repeat-until-correct	Informing the learner about an incorrect response	Try again	Cognitive
6	If the student corrects the mistake at this point	Well done. You did a great job	Maintaining motivation	Appraisal of the achieved objective of the lesson	Motivational	Affective
7	If the student has difficulties	It's okay. Please have a look at your answer	Maintaining subjective well-being	Emotional support	Emotional	Affective

	in finding the correct response	again. You can do it!				
8	When the student cannot realize his/her mistake	Let me help you, please repeat after me [The teacher provides the correct response]	Providing correct answer	Knowledge of correct response	Correct response	Cognitive
9	If the student corrects the mistake at this point	Great. Congratulations	Maintaining motivation	Appraisal of the achieved objective of the lesson	Motivational	Affective
10	When the student still cannot reach the correct answer	The teacher provides the correct answer and explains why.	Providing correct answer	Knowledge of correct response	Correct response	Cognitive
	After giving feedback to the students,					
11	The teacher scans the text that belongs to the student who is standing in front of the board. If the answers are correct	Exactly right. You are very good at that.	Informing the student and maintaining motivation	Highlighting the achievement and appraisal	Verification	Both Cognitive and Affective
12	The teacher invites the student, who is standing in front of the board, to ask two questions from the question-and-answer pool	Well, do you have any questions for me?	Maintaining instructions	Getting the student involved in the conversation	Directive script	Affective
13	The student asks a	[The teacher gives pre-determined	Maintaining interaction	Getting the student involved in	Conversational script	Affective

	question from the pool	answers according to questions]		the conversation		
14	When the student asks the teacher to repeat the response	[The teacher repeats the previous response]	Clarification	Making sure that students understand the response	Conversational script	Affective
15	The teacher invites another student to the board.	Dear …... could you come here?	Maintaining instructions	Getting ready for interaction	Directive script	Affective
			The cycle starts from the beginning again			

Appendix 3. Pre-test matching with objectives and units of the lesson

Questions	Objectives	Units
pre_01	Students will be able to introduce themselves and meet other people.	Unit 1: Hello
pre_02	Students will be able to talk about hobbies, likes/dislikes, and abilities in a simple way.	Unit 3: Games and Hobbies
pre_03	Students will be able to understand the time.	Unit 4: My Daily Routine
pre_04	Students will be able to talk about hobbies, likes/dislikes and abilities in a simple way.	Unit 3: Games and Hobbies
pre_05	Students will be able to understand simple directions to get from one place to another	Unit 2: My Town
pre_06	Students will be able to understand simple directions to get from one place to another	Unit 2: My Town
pre_07	Students will be able to understand simple personal information.	Unit 1: Hello
pre_08	Students will be able to talk about hobbies, likes/dislikes, and abilities in a simple way.	Unit 3: Games and Hobbies
pre_09	Students will be able to understand the time.	Unit 4: My Daily Routine
pre_10	Students will be able to understand information about important places.	Unit 2: My Town
pre_11	Students will be able to talk about hobbies, likes/dislikes, and abilities in a simple way.	Unit 3: Games and Hobbies
pre_12	Students will be able to understand simple suggestions concerning illnesses.	Unit 5: Health
pre_13	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine
pre_14	Students will be able to understand information about important places.	Unit 2: My Town
pre_15	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine

pre_16	Students will be able to name the common illnesses in a simple way.	Unit 5: Health
pre_17	Students will be able to name the common illnesses in a simple way.	Unit 5: Health
pre_18	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine
pre_19	Students will be able to talk about hobbies, likes/dislikes, and abilities in a simple way.	Unit 3: Games and Hobbies
pre_20	Students will be able to understand simple suggestions concerning illnesses.	Unit 5: Health

Appendix 4. Follow-up Activity

Follow-Up Activity

1) Look at the map on the board. Pick one public building from the picture above and locate it

…………………………………………………………………………………….…………

2) What do you like doing in your free time?

…………………………………………………………………………………….…………

3) Which classes do you have on a typical weekday (It can be any weekday)?

…………………………………………………………………………………….…………

4) What time is it now?

……………………………………………………………………...……………………..

5) Imagine that one of your friends has the flu. Please give some advice to him/her.

…………………………………………………………………………………………….

Appendix 5. Motivation questionnaire for the APA condition

Motivation Questionnaire

I would like to hear about your experience with the activity. Please complete the following questionnaire. Any information you provide will be kept confidential, so please be honest and thorough in your answers.

Regarding with the activity, answer how strongly you agree or disagree with each statement.

	No, not at all	Not quiet	Neutral	Yes, to some extent	Yes, a lot
Did Uku keep your attention during the activity?					
Did Uku, assisting your teacher, help you feel that the activity is relevant to you for English lesson?					
Did Uku, performing in the class, help you feel confident about completing the activity?					
Did Uku, assisting your teacher, make you feel satisfied with your overall perception about the lesson?					
Would you like Uku to join another lesson in the future?					
In general, I feel motivated as Uku, assisting the teacher in this activity?					

Appendix 6. Motivation questionnaire for the teacher condition

Motivation Questionnaire

I would like to hear about your experience with the activity. Please complete the following questionnaire. Any information you provide will be kept confidential, so please be honest and thorough in your answers.

	No, not at all	Not quiet	Neutral	Yes, to some extent	Yes, a lot
Did the teacher keep your attention during the activity?					
Did the teacher help you feel that the activity is relevant to you for English lesson?					
Did the teacher help you feel confident about completing the activity?					
Did the teacher, make you feel satisfied with your overall perception about the activity?					
Would you like the teacher to run another activity like today in the future?					
In general, I feel motivated with the teacher, giving feedback, in this activity?					

Appendix 7. Post-test matching with objectives and units of the lesson

post_01	**Students will be able to introduce themselves and meet other people.**	**Unit 1: Hello**
post_02	Students will be able to understand simple directions to get from one place to another.	Unit 2: My Town
post_03	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine
post_04	Students will be able to talk about hobbies, likes/dislikes, and abilities in a simple way.	Unit 3: Games and Hobbies
post_05	Students will be able to talk about hobbies, likes/dislikes, and abilities in a simple way.	Unit 3: Games and Hobbies
post_06	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine
post_07	Students will be able to understand information about important places.	Unit 2: My Town
post_08	Students will be able to understand simple, oral texts about hobbies, likes/dislikes and abilities.	Unit 3: Games and Hobbies
post_09	Students will be able to understand simple suggestions concerning illnesses.	Unit 5: Health
post_10	Students will be able to understand information about important places.	Unit 2: My Town
post_11	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine
post_12	Students will be able to understand information about important places.	Unit 2: My Town
post_13	Students will be able to understand the time.	Unit 4: My Daily Routine
post_14	Students will be able to understand simple personal information.	Unit 1: Hello
post_15	Students will be able to understand simple, oral texts about hobbies, likes/dislikes and abilities.	Unit 3: Games and Hobbies
post_16	Students will be able to name the common illnesses in a simple way.	Unit 5: Health

post_17	Students will be able to understand simple suggestions concerning illnesses.	Unit 5: Health
post_18	Students will be able to understand simple, oral texts about hobbies, likes/dislikes and abilities.	Unit 3: Games and Hobbies
post_19	Students will be able to name the common illnesses in a simple way.	Unit 5: Health
post_20	Students will be able to use simple utterances to talk about daily routines.	Unit 4: My Daily Routine

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