2D Animations: Teaching in Kitchen Skills to Individuals with Intellectual Disability

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Abstract

The present study investigated the effectiveness of an animation-based teaching package designed and developed to teach four different in-kitchen skills to individuals with intellectual disabilities (ID). A comprehensive teaching package was intended to teach lighting a stove, cooking eggs in the pan, setting a dining table, and clearing the dining table within the scope of the present work. Multiple baselines across behavior design were applied as single-subject research. The participants included three secondary public-school children with moderate ID in Aksaray, Turkey. The results reveal that the animation-based teaching package, in conjunction with the direct instruction model, has a positive effect in teaching daily living (DL) skills to individuals with ID, which is significant for greater independence across various settings.

Keywords: intellectual disability, animation, daily living skills, computer-aided instruction

2B Animasyonlar: Zihinsel Yetersizliği Olan Bireylere Mutfak İçi Beceri Öğretimi

Öz

Bu çalışmada, zihinsel yetersizliği (ZY) olan bireylere dört farklı mutfak içi beceriyi öğretmek için tasarlanan ve geliştirilen animasyon temelli bir öğretim paketinin etkililiği araştırılmıştır. Mevcut çalışma kapsamında çakmakla ocak yakma, tavada yumurta pişirme, yemek masası kurma ve yemek masası toplama konularına yönelik kapsamlı bir öğretim paketi tasarlanmıştır. Bu doğrultuda araştırmada davranışlar arası yoklama evreli çoklu yoklama modeli kullanılmıştır. Çalışmaya Aksaray İli'nde Milli Eğitim Bakanlığı'na bağlı bir özel eğitim ve uygulama okulunda II. kademeye devam eden orta düzeyde zihinsel yetersizliği olan üç öğrenci katılmıştır. Sonuçlar, doğrudan öğretim modeliyle birlikte animasyon temelli öğretim paketinin, zihinsel yetersizliği olan bireylere günlük yaşam becerilerini öğretmede olumlu bir etkiye sahip olduğunu göstermektedir.

Anahtar kelimeler: zihinsel yetersizlik, animasyon, günlük yaşam becerisi, bilgisayar destekli öğretim

INTRODUCTION

Intellectual disability (ID) has been recognized as a developmental disorder that causes several enormous deficits that affect a variety of domains, such as conceptual, adaptive, and social (American Association on Intellectual and Developmental Disabilities, 2013). Individuals with ID lack motivation and have difficulties communicating, interacting, and concentrating (Rose et al., 2005), which impedes their learning processes and employment rates (Newman et al., 2011). Hence, individuals with ID have unique, complex learning needs (Sulaimani & Bagadood, 2022).

For a long time, efforts have been spent preparing individuals with ID to live independently and gain self-determination skills. Daily living (DL) skills are one of the critical learning areas for individuals with ID since they are necessary to obtain desirable life and employment opportunities (Heller et al., 2005). In-kitchen skills are among the essential multistep skills for developing autonomous living skills, including food preparation, cooking, preparing/gathering tables, etc. Such tasks lead to greater independence within various settings (Graves et al., 2005).

Considering that individuals with ID have difficulties in learning and recalling (Rezaiyan et al., 2007; Segatto et al., 2017; Wehmeyer et al., 2004), there is a need for practices that they can repeat over and over in the learning process. To acquire new skills and obtain independence and quality of life (Gooden-Ledbetter et al., 2007), they rely on effective teaching materials, strategies, and techniques (Sulaimani & Bagadood, 2022). Integrating assistive technology (AT) into learning processes is a promising way of addressing the issues encountered by individuals with ID. A wealth of research has investigated the effectiveness of AT and ensured empirical evidence on its contributions to teaching several skills to individuals with ID (Goo et al., 2016; Johnson et al., 2013; Kang et al., 2021; Taber-Doughty et al., 2011; Yalçın et al., 2023; Yeni et al., 2020). Computer-assisted instruction (CAI) as a current form of AT has great importance in developing necessary skills (Kamalı-Arslantaş et al., 2022; Ramdoss et al., 2012), and there is a tendency for more CAI studies (Burns et al., 2019) due to the technological improvements, ease access options and the educational affordances they ensure (Kamalı-Arslantaş et al., 2022). These educational affordances include the opportunity of repeated practice of the same task (Mechling, 2007), controlling of own learning processes (Kagohara et al., 2013; Kamali Arslantas et al., 2021), effective learning of skills (Chiu et al. 2019; Hopcan & Tokel, 2021; Polat et al., 2019), and decreasing the time spent for intervention (Yeni et al., 2020). Naturally, these affordances lead to educational gains such as skill acquisition, maintenance and generalization of skills, and motivation for more technology-based studies. Therefore, these individuals become less dependent and more talented (Mechling, 2007) as they develop autonomy (Van Laarhoven et al., 2009). Existing research reveals that several instructional strategies can be integrated into those processes, and integrating audio and video materials, including modeling or role-playing, has been identified as effective. Among those strategies, video-based instruction has attracted many researchers due to the evidence-based practices the studies provided (Ayres & Cihak, 2010; Hansen & Morgan, 2008; Mechling & Cronin, 2006; Mechling et al., 2015; Norman et al., 2001). Despite the positive outcomes of video-based instruction, students with special needs may need more interest in engaging in the desired behavior and still need more enjoyable content representation (Ohtake et al., 2015). Adding animation elements to video-based instruction is one of the ways suggested in the literature.

An alternative strategy to improve the skills of individuals with ID is animation-based video training (Cakmak & Cakmak, 2015; Drysdale et al., 2014; Eldeniz et al., 2017; Fujisawa et al., 2011; Shepherd, 2012; Yalçın et al., 2023), which was found to be enjoyable and increases curiosity and the ability to focus on the education of ID (Yeni et al., 2020).

Animations have several advantages when it comes to representing information effectively. Firstly, they can simplify complex concepts and make them easier to understand by breaking them down into smaller, more manageable parts. Secondly, animations can help learners visualize abstract or difficult-to-grasp concepts by providing visual cues that aid in retention and recall. Thirdly, animations can be more engaging than static text or images, as they can create an immersive and interactive learning experience. Research has shown that animations promote higher-order thinking skills such as analysis, synthesis, and evaluation (Barak & Dori, 2005). By presenting information in an interactive and engaging format, learners are more likely to think critically about the information presented and draw connections between different concepts. This can lead to a deeper understanding of the material being taught.

Moreover, animations can provide positive learning experiences for learners. Ohtake et al. (2015) found that animation-based instruction can be particularly effective for teaching skills to learners with special needs, such as those with autism spectrum disorder. Using animation-based video modeling to teach bathroom skills to a

student with autism spectrum disorder resulted in positive outcomes for the learner. Similarly, Bellini and Akullian (2020) noted that students with special needs engage more with videos when they are supported with animations or avatars. In summary, animations can be a powerful tool for representing information effectively and engagingly, particularly for learners with special needs. By providing visual cues, simplifying complex concepts, and promoting higher-order thinking skills, animations can lead to positive learning experiences and better retention of information.

However, existing research does not provide sufficient information related to the use of animation-based interventions in the education of people with disability. It is important to have evidence-based practices to understand the effectiveness of animation-based video instruction in teaching various skills. While existing research supports using animations in education, more studies are needed to determine this approach's benefits and limitations. Studies should be conducted with appropriate research designs and methodologies to establish the efficacy of animation-based video instruction across different subject areas and for learners with different backgrounds and abilities.

The present study investigated the effectiveness of an animation-based teaching package designed and developed to teach four different in-kitchen skills to individuals with ID. A comprehensive teaching package was designed to teach lighting a stove, cooking eggs in the pan, setting a dining table, and clearing the dining table. These skills are critical to improving participants' independent living skills and might help them become more autonomous. The current study investigated the performance of students during and after the intervention. The findings presented in the study extend the existing literature on the usage of animations in special education by examining the effectiveness of using animation-based videos in learning DL skills by individuals with ID. The animation used in this research is essential in ensuring effective time use, standardizing teaching, and minimizing practitioner-based limitations.

Research Questions

1. To what extent does the implementation of the animation-based daily life skills teaching package program impact the lighting stove skills acquisition of students with ID in the life skills classroom as measured by the percentage of correct lighting stove steps performed?

2. To what extent does the implementation of the animation-based daily life skills teaching package program impact cooking eggs in a pan skills acquisition of students with ID in a life skills classroom as measured by the percentage of correct cooking eggs in pan steps performed?

3. To what extent does the implementation of the animation-based daily life skills teaching package program impact the preparation of dining table skills acquisition of students with ID in the life skills classroom as measured by the percentage of correct preparation of the dining table skill steps performed?

4. To what extent does implementing the animation-based daily life skills teaching package program impact clearing the dining table skills acquisition of students with ID in the life skills classroom as measured by the percentage of correct clearing the dining table skills steps performed?

METHOD

Participants

The participants in this study included three secondary public-school children (Ahmet, Ayşe, Cansu) with moderate ID in Aksaray. Participants were enrolled in special education schools. These individuals met the following criteria: (1) diagnosed with moderate ID without comorbid additional disability, (2) attended school regularly, and (3) were not able to use the DL skills included in the current study. The researchers determined three students with these prerequisites and a substitute student, and the study started after the necessary approval and permissions were obtained.

The first participant, Ahmet, was a 16-year-old male student with moderate ID. Ahmet exhibits aggressive problem behavior. Ayşe and Cansu are 17-year-old female students with moderate ID who do not have any problem behaviors.

All participants are high school students in a particular education school, and at the same time, they attend an exceptional education and rehabilitation center two days a week. Based on the teacher and family interviews, it was determined that Ahmet performed many self-care skills independently, could count rhythmically from one to ten, recognized numbers, recognized some letters and sounds, and performed many of his communication skills independently. Ayşe was able to perform her self-care skills independently. She can also count rhythmically from

one to ten and recognize some letters. She can perform many of her communication skills independently. Cansu can perform self-care and communication skills independently. She can count rhythmically from one to nine. She does not have any academic skills related to reading. All participants need to be taught DL skills.

Research Design

A multiple baseline across behavior design was implemented as a single-case study to investigate the effectiveness of an animation-based teaching package in teaching four DL skills to individuals with ID. This model does not require continuous baseline data and controls factors that threaten internal validity, such as maturation and measurement. In addition, factors such as many repetitions and participant characteristics in this model effectively control the external validity of the model (Tekin-İftar, 2012).

Setting and Materials

Baseline, intervention, follow-up, and generalization sessions were conducted in a particular classroom. In this context, while the baseline, intervention, and follow-up sessions were held in the life skills classroom, the generalization session was held in the cafeteria within the school. The life skills classroom includes a dining table, chairs, kitchen cabinets, a counter, and a refrigerator. The researchers provided a countertop stove similar to the one used in the animation and placed it on the kitchen counter. In addition, the researchers provided other materials (lighter, pan, egg, oil, tablecloth, plate, glass, spoon, fork, knife, napkin holder, and saltshaker) to be used and placed in the kitchen cabinets. A laptop was used for the animation-based teaching package delivery. Accurate materials related to the four DL skills were used to examine whether these skills can be generalized to natural settings. For "burning the stove" skill; cooker and lighter; for "cooking eggs in a pan" skill; cooker, pan, oil, eggs, salt, and wooden spoon; for "preparing the dining table" and "clearing the dining table" skills; tablecloth, large and small plates, glasses, spoons, forks, knives, napkins, and saltshakers were used.

The study's dependent variables were the skills of burning the stove, cooking eggs in a pan, preparing the dining table, and clearing the dining table. The independent variable was the instruction provided by the animation-based teaching package.

Animation-Based Teaching Package

A web-based animation-based teaching package was designed, developed, implemented, and evaluated with the collaboration of special education and instructional technology experts to improve the DL skills of students with ID. The research team conducted task analysis for these skills after observing individuals performing the tasks. After analysis, the team performed the steps and recorded videos to determine whether the skills were correctly defined (see Table 1, Table 2, Table 3, and Table 4).

Table 1. Task Analysis Steps: Burning the Stove

Step No	Task analysis
1	Take the lighter from the drawer.
2	Go to the stove.
3	Light the stove by pressing the button of the lighter.
4	Turn on the stove with your other hand and remove your hand.
5	Bring the lighter closer to the stove.
6	Light the stove.
7	Extinguish the lighter by pulling your hand off the lighter button.
8	Put the lighter in the drawer

Table 2. Task Analysis Steps: Cooking Eggs in a Pan

Step No	Task analysis
1	Take the pan from the cabinet.
2	Put the pan on the stove.
3	Take the oil.
4	Pour some oil into the pan.
5	Leave the oil where you took it.
6	Turn on the stove.
7	Take the egg out of the refrigerator.
8	Crack the egg into the pan.
9	Throw away the eggshells.
10	Add some salt to the egg.

11	Put the salt where you took it.
12	Take the wooden spoon from the drawer.
13	Stir the eggs with a spoon until they are cooked.
14	When the eggs are cooked, put the spoon on the counter.
15	Turn off the stove.

Table 3. Task Analysis Steps: Preparing the Dining Table

Step No	Task Analysis
1	Take the tablecloth from the cupboard.
2	Layout the tablecloth.
3	Take the big plate from the cabinet.
4	Put the large plate on the table in front of the chair.
5	Take the small plate from the cabinet.
6	Place the small plate on top of the large plate.
7	Take the fork from the drawer.
8	Put the fork on the left side of the large plate next to it.
9	Take the knife from the drawer.
10	Put the knife on the right side of the large plate.
11	Take the spoon from the drawer.
12	Put the spoon next to the knife.
13	Take the napkin from the drawer.
14	Put the napkin next to the fork.
15	Take the glass from the cupboard.
16	Put the glass next to the knife and spoon.
17	Take the saltshaker from the cabinet.
18	Put the saltshaker on the table.

Table 4: Task Analysis Steps: Clearing the Dining Table

Step No	Task analysis
1	Take the saltshaker off the table.
2	Put the saltshaker on the counter.
3	Take the glass from the table.
4	Put the glass on the counter.
5	Put the napkins inside the small plate.
6	Take the small plate from the table.
7	Put the small plate on the counter.
8	Put the spoon on the large plate.
9	Put the knife on the large plate.
10	Put the fork on the large plate.
11	Take the big plate from the table.
12	Put the large plate on the counter.
13	Remove the tablecloth.
14	Put the tablecloth on the counter.

The web-based animation-based teaching package is based on the direct instruction approach, consisting of modules for each animation, such as "modeling," "guided practice," and "independent practice," by this approach. There is also an "assessment" module for each animation. One of the two avatars named "Ege" and "Ece" performs the skills in all animations (see Figure 1). In the modeling module, by the instructions given by a voice-over, the character models all sub-steps of the skill. In contrast, the student is expected to apply the related skills with natural materials in the guided practice and independent practice modules. When the student cannot perform the skill correctly, the process restarts with the previous module. The implementation process was conducted under the guidance of the research team.
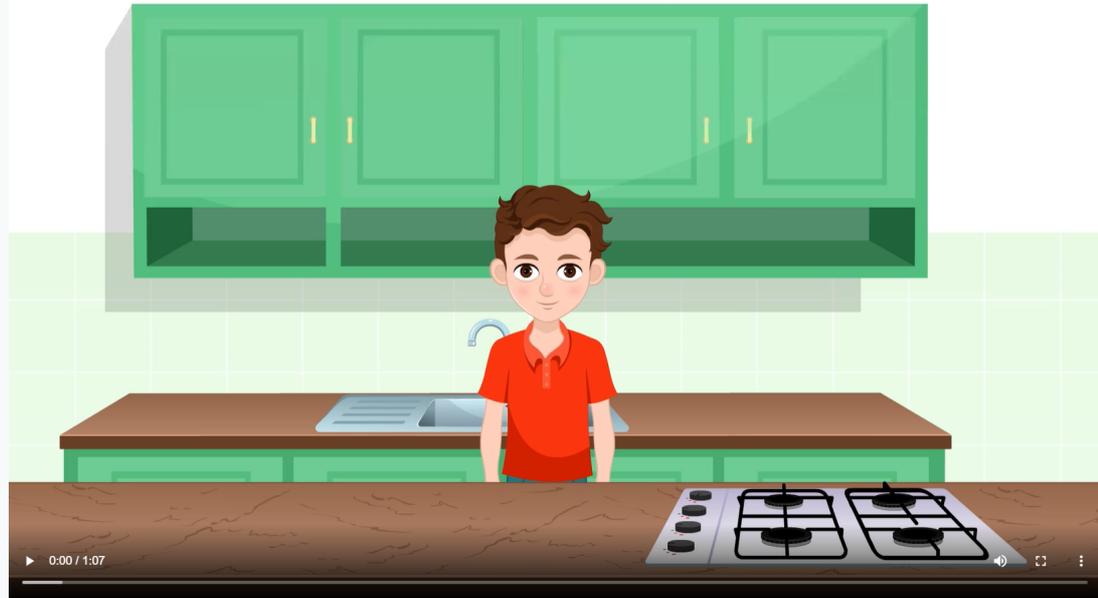
Figure 1. A Screenshot of the Animation Based Teaching Package

The Procedure of the Study

Baseline, intervention, probe, follow-up, and generalization sessions were conducted throughout the process. Before baseline, participants were determined, and informed consent was collected from the legally authorized representative of the participants. All the participants were rewarded based on their preferences.

During the *baseline* session, three repetitive baseline data were gathered from students. The researchers told the participants to do the relative daily task, and they were given a single opportunity to reflect on the effectiveness of the intervention. After the first intervention, *multiple probe sessions were conducted before each intervention,* and at least three sessions of data were collected until stable data were obtained. The process was conducted similarly to the baseline session. *Daily probe* sessions were organized one day after the intervention session before starting the subsequent intervention. The primary instruction was given in the probe sessions, and the students were expected to perform the skill. Reinforcements were not provided to the students at this stage. The criterion for all skills was set at 100%.

Intervention sessions were implemented four days a week, an intervention session per day. Researchers first explained the goal of the related skill to the participant. Then, the rules of the study were explained, and a specific reinforcement was determined. Then, the materials were introduced. After completing these preparations, the intervention sessions were conducted based on the modules. In the *modeling* module, the researcher and the student sat before the screen. The researcher selected the relevant skill from the screen, and the student watched the modeling steps of the skill. The researcher checked that the student was watching the animation. After the student watched the modeling module of the animation at least three times, the guided practice step was started. In guided practice, the researcher explained the procedure and said participation would be reinforced with preferred rewards. The avatar guided participants for each DL task step during the guided practice step. After the avatar in the animation told the participant what to do, the video was stopped, and the student waited 5 seconds to apply the activity step with natural materials. When the participant did the step correctly, it was reinforced, and the next step was taken by pressing the "forward arrow." When the participant reacted incorrectly or was unresponsive, the video was replayed. All the activity steps were completed in the same process. The guided practice session was terminated after the student performed the skill without assistance, and an independent practice session was started. In the independent practice session, the avatar told the participant to do the task alone with all the steps in the natural environment. In this session, if needed, the modeling stage was started again, and if the student performed the skill correctly at 80%, the intervention was terminated. The same procedures were followed for all DL skills until completed.

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Follow-up data were collected to investigate the persistence of the new skill 7 and 14 days later. Participants were expected to perform the DL skills with relative steps. At this stage, the participants needed to be provided with hints or reinforcements. Furthermore, generalization sessions were conducted one week after the participants reached the 80% and 100% criteria for two follow-up sessions.

Data Collection

Data were gathered with forms developed to record the task chain. To calculate the percentage of correct steps completed independently, the number of completed steps was divided by the total number of steps of the task analysis and then multiplied by 100.

Inter-observer reliability data were collected to ensure reliability. For a randomly selected 30% of each participant, different types of sessions and inter-observer reliability data were coded. Interobserver reliability was calculated using Agreements / Agreements + Disagreements x 100 (Kazdin, 1982). In this context, the interobserver reliability of the study was calculated as 93%, 100%, and 100%, respectively, for Ahmet, Ayşe, and Cansu.

In order to measure the social impact of the study (Kennedy, 1992), social validity was investigated. For that purpose, five open-ended questions were prepared. Interviews were conducted with one teacher and three families of the participant students.

Data Analysis

An experimental criterion was conducted, and data were analyzed with visual graphs. The range of interpretation of the graphs, the rapid effect (comparison of the last three sessions of the baseline with the first three sessions of the intervention phase), and the percentage of overlapping and non-overlapping data (the proportion of the intervention session above the highest baseline point) were calculated. Social validity data obtained from families and teachers were analyzed by the descriptive analysis method.

Research Ethics

The researchers applied ethical principles throughout the study, ensuring respect for persons, beneficence, and justice. All participants were assured of their well-being, safety, and privacy. Informed consent was gathered from each student's legally authorized representative to protect the privacy and ensure the confidentiality of the data. The researchers obtained IRB approval from the Aksaray University Ethics Committee for Human Research.

FINDINGS

Participants were required to reach 100% success for lighting the stoves and 80% success criterion for the 3 DL tasks. Ahmet met the success criterion and maintained success for all four behaviors. Ahmet reached the success criterion for *lighting a stove* at a rate of 100% (Ranj= 100%-33%) at the end of seven intervention sessions, *cooking eggs in a pan* at a rate of 86% (Ranj= 86%-40%) at the end of six intervention sessions; *prepare the dinner table* at a rate of 94% (Ranj= 94%-66%) at the end of five intervention sessions, and *clearing the dinner table* at the rate of 92% (Ranj= 92%-57%) at the end of five intervention sessions. These rates showed 100% stability in all probe sessions after the intervention phase. In addition, the absolute level change analysis was performed for all skills, and the immediate effect was calculated. The difference between the last data of the first phase and the first data of the second phase was (33%-12%) for *lighting a stove;* (40%-0%) for *cooking eggs in a pan*; (66%-0%) for *preparing a dining table*, and (57%-0%) for *clearing the dining table*. The effect size of Ahmet's PND score was calculated between baseline and intervention as 100, which is highly effective (Scruggs et al., 1987).

Ayşe also met the success criterion and maintained 100% success for all four behaviors. Ayşe reached the success criterion *for lighting a stove* at a rate of 100% (Ranj= 100%-37%) at the end of eight intervention sessions; *cook eggs in a pan* at a rate of 86% (Ranj= 86%-26%) at the end of six intervention sessions; *prepare the dinner table* at a rate of 100% (Ranj= 100%-61%) at the end of five intervention sessions and *clearing the dinner table* at the rate of 100% (Ranj= 100%-64%) at the end of four practice sessions. These rates showed 100% stability in all probe sessions after the intervention phase. The difference between the last data of the first phase and the first data of the second phase was (37%-0%) for *lighting a stove;* (26%-13%) for *cooking eggs in a pan*; (61%-11%) for *preparing a dining table*, and (64%-14%) for *clearing the dining table*. The effect size of the PND score of Ayşe was calculated between baseline and intervention as 100, which is highly effective.

Likewise, Ahmet and Ayşe, Cansu met the success criterion and maintained 100% success for all four behaviors. Cansu reached the success criterion for *lighting a stove* at a rate of 100% (Ranj= 100%-25%) at the end

of five intervention sessions, *cooking eggs in a pan* at a rate of 100% (Ranj= 100%-60%) at the end of three intervention sessions; *prepare the dinner table* at a rate of 100% (Ranj= 100%-55%) at the end of five intervention sessions and *clearing the dinner table* at the rate of 100% (Ranj= 100%-57%) at the end of four practice sessions. These rates showed 100% stability in all probe sessions after the intervention phase. The difference between the last data of the first phase and the first data of the second phase was (50%-25%) for *lighting a stove;* (60%-6%) for *cooking eggs in a pan*; (55%-11%) for *preparing a dining table*, and (57%-14%) for *clearing the dining table*. The effect size of the PND score of Cansu was calculated between baseline and intervention as 100, which is highly effective.

The differences in absolute level change showed that the animation-based teaching package increasingly immediately affected all participants in the desired direction for all skills. Besides, the percentage of overlapping data is 0, and the percentage of non-overlapping data is 100% for all skills, implying that the animation-based teaching package effectively teaches these skills. In the follow-up sessions held on the 7th and 14th days after the intervention, participants achieved 80%-100% of all the skills. These data show that the skills learned with an animation-based teaching package continue to persist even after time has passed.

The following three graphs (Figure 2, Figure 3, and Figure 4) show results for all behaviors of each participant. The horizontal axes of the graphs show the implementation sessions, while the vertical axes show scores for each DL skill.
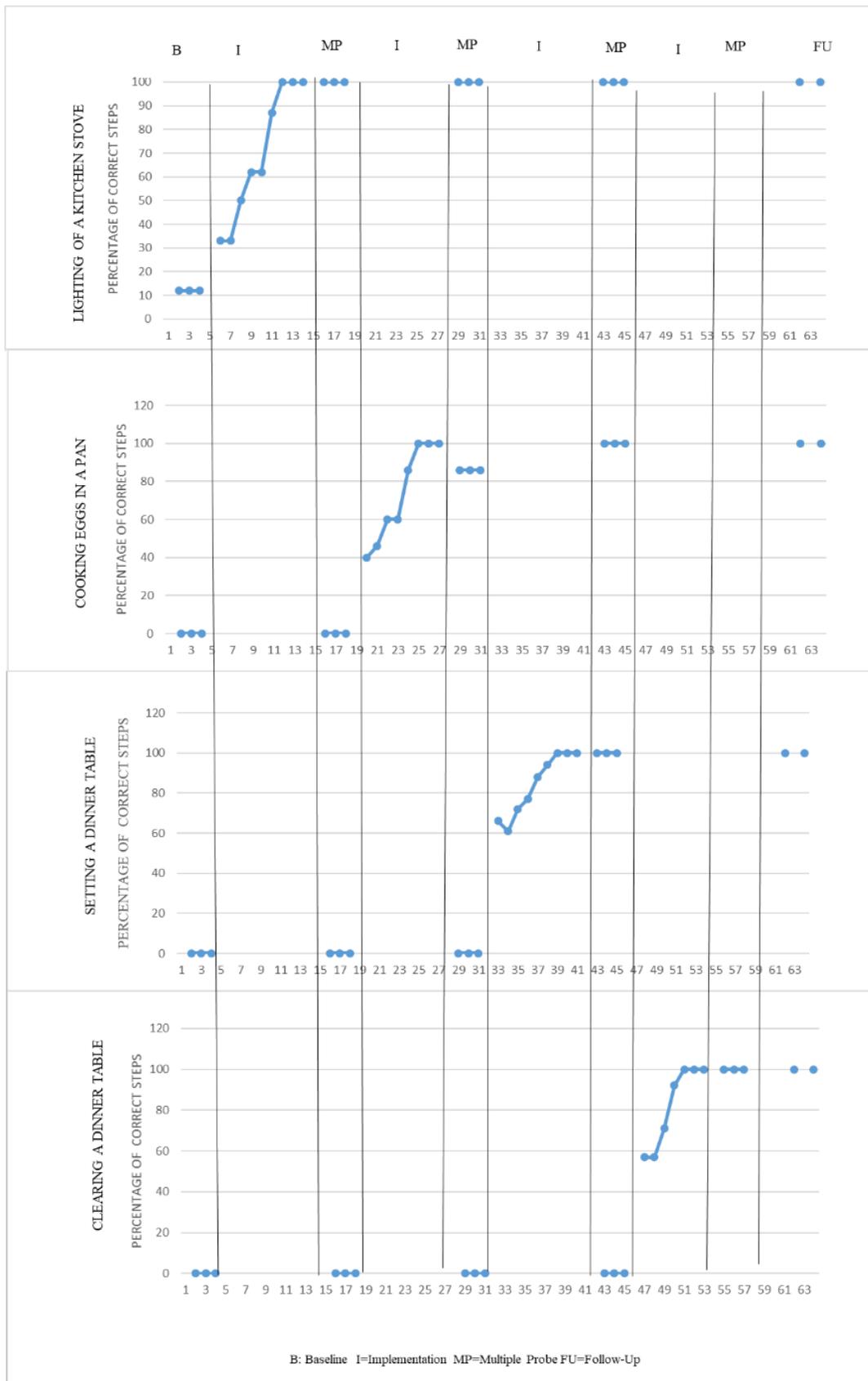
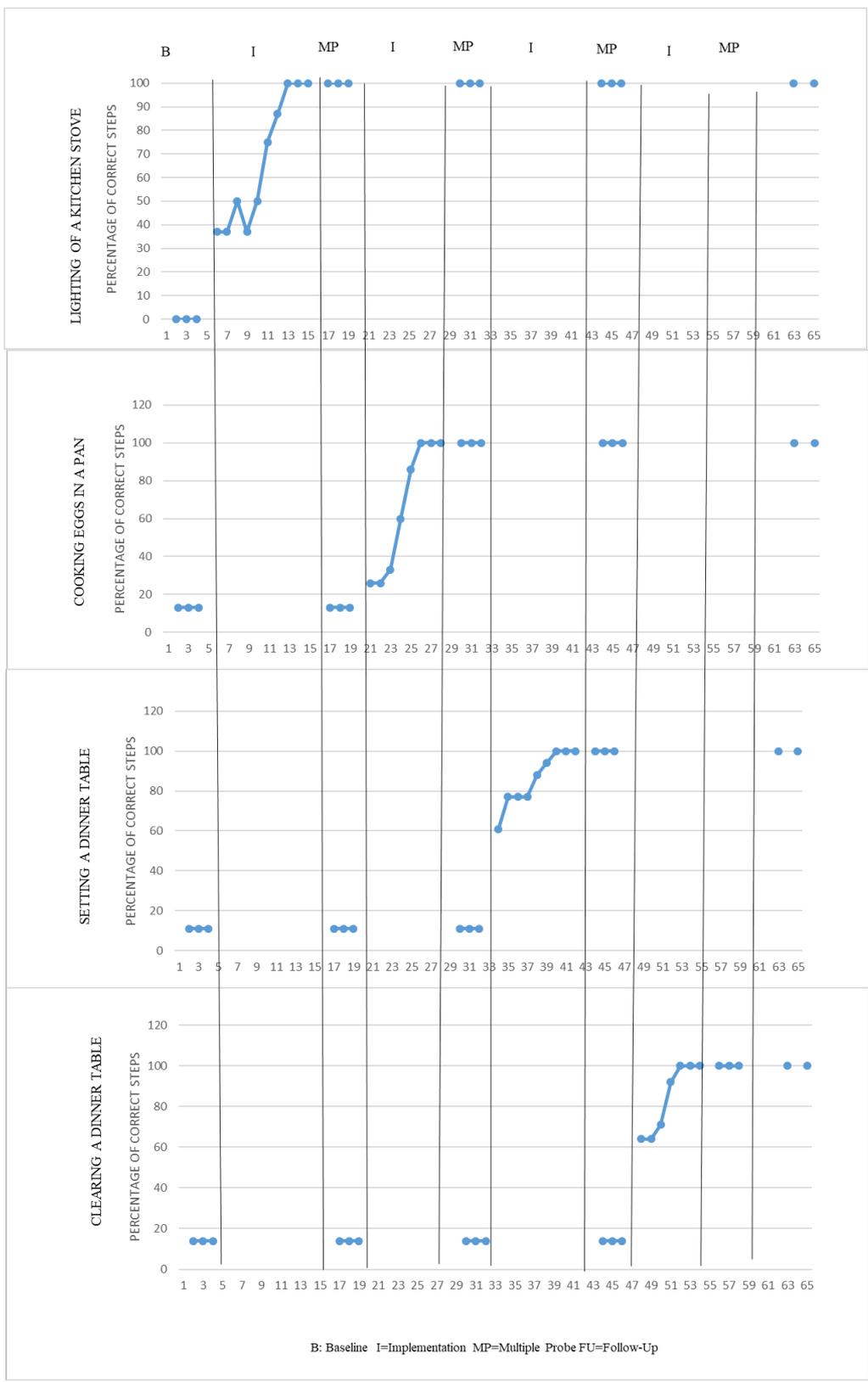***Figure 2.*** Results for Ahmet
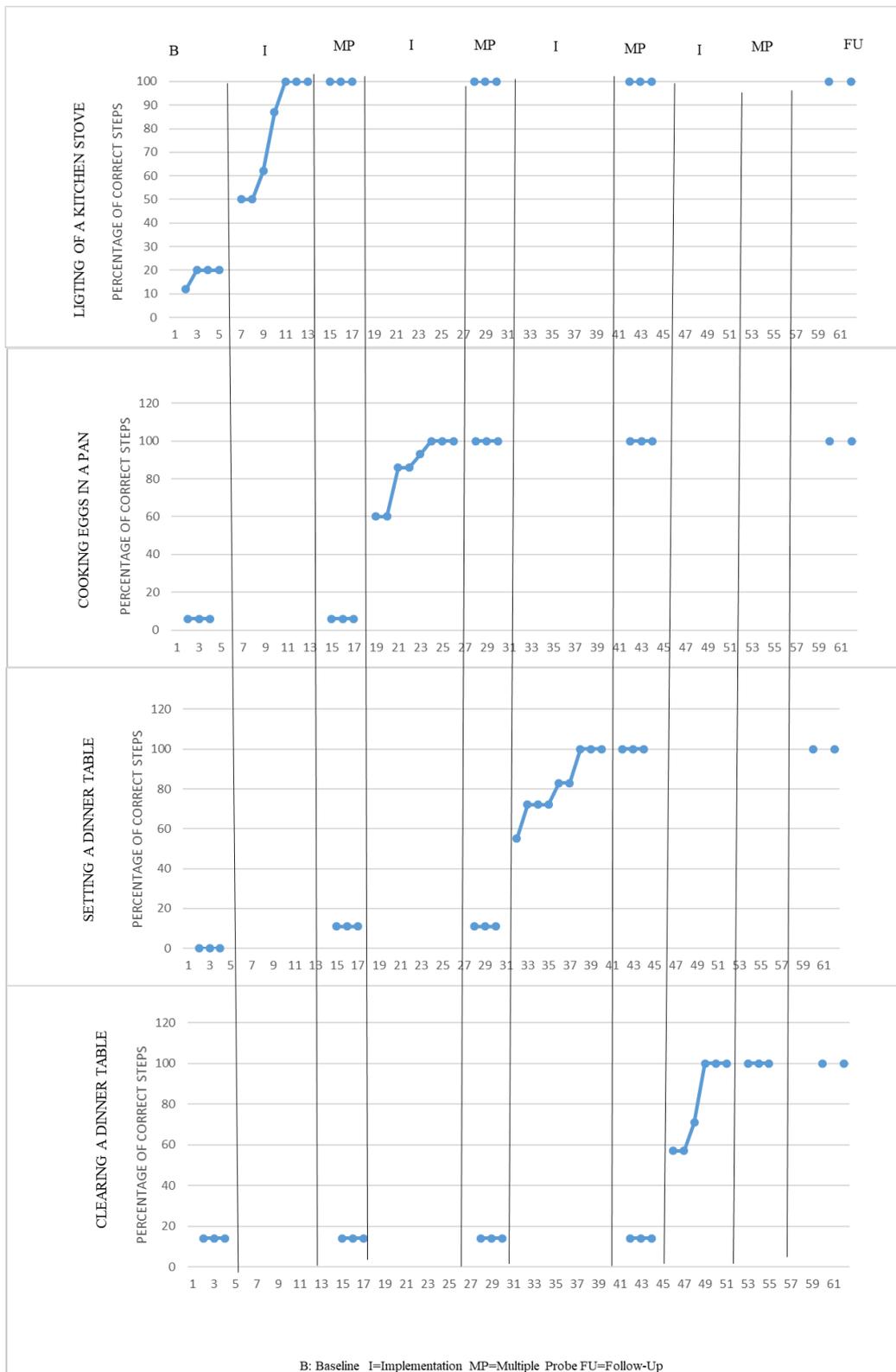
Figure 3. Results for Ayşe

Figure 4. Results for Cansu

Generalization data for three participants were gathered simultaneously for all the DL skills held in the cafeteria within the school. Participants were required to listen to the researcher and then apply their relative DL skills. The following table represents the generalization data results.

Table 5. Generalization Results

Participant	Pretest-Posttest	Lighting Stove (%)	Cooking Eggs in a Pan (%)	Setting a dining table (%)	Clearing a dining table (%)
Ahmet	Pretest	12	0	0	0
	Posttest	100	86	94	92
Ayşe	Pretest	0	13	11	14
	Posttest	100	83	100	100
Cansu	Pretest	20	6	0	0
	Posttest	100	100	100	100

After the study, each participant's mother and teacher were interviewed to measure the intervention's social impact. The parents thought the animation-based teaching package was handy and effective in helping the participants learn DL skills. All the families stated that their children independently performed the skills they learned at home. The students' families also highlighted that their children enjoyed participating in the study. Furthermore, parents indicated that they would like their children to participate in future studies and learn other skills they need in an animation-based learning environment. According to the teacher, participants highly enjoyed the intervention procedure. They favored that the animations were a good motivator for the participants and helped them to improve their independence.

DISCUSSION AND CONCLUSION

The present study contributes to the literature, providing information about the effect of animation-based video instruction with computers for teaching DL skills to individuals with ID. The findings that the animation-based teaching package, in conjunction with direct instruction, can facilitate learning progress for individuals with ID is a positive step forward in developing evidence-based practices for this population.

The fact that the results of this study are consistent with previous studies that have shown positive learning outcomes with animation-based instruction, both for students with special needs (Yeni et al., 2020) and without (Barak & Dori; Rosen, 2009), reinforces the idea that animation-based instruction can be a powerful tool for teaching a wide range of skills. The idea that animation-based instruction can aid in the transition from abstract to concrete thinking is also essential. This is because abstract concepts can be complicated for individuals with ID to grasp, and animations can visually represent these concepts, making them more concrete and easier to understand. Overall, this study provides valuable insights into the effectiveness of animation-based video instruction for teaching DL skills to individuals with ID and adds to the growing body of literature supporting animations in education.

According to the visual analysis of the three participants' (Ahmet, Ayşe, Cansu) single-subject data, three student participants presented substantial progress with the correct percentage step test based on the 80% success criterion for three skills and 100% for lighting a stove. Participants performed between 0 and 20% of the steps correctly in all baseline sessions.

Intervention sessions were conducted until three probe sessions met the 80% criteria. Intervention for all students was changed in the desired direction. Ahmet reached the success criterion for the stove burning after seven sessions, Ayşe reached 80% success after eight sessions, and Cansu learned after five sessions. Despite Ayşe's changing results while learning these skills, it did not cause her to be unsuccessful since the behavioral change was in the desired direction. After six sessions, Ahmet and Ayşe reached the success criterion for cooking eggs in a pan.

In comparison, Cansu reached it after three sessions and experienced a substantial increase in the correct percentages. After five sessions, all participants reached the success criterion for preparing the dining table.

Despite Ahmet and Cansu's changing results, they became successful. Their changing results were only observed in learning these skills, which might be related to the existence of more steps. Lastly, Ahmet reached the success criterion for collecting dining tables after five sessions, while Ayşe and Cansu reached it after four sessions. All participants learned that skill in a shorter time. This might be related to the fact that it is a skill that complements the skill of setting the table. The generalization phase supported the desired change of behaviors during training, and all students maintained positive change in all behaviors. Despite the first skill (lighting a stove) having the least number of steps among other skills, participants' learning process of that skill seems to take longer. Since the intervention was started with that skill, this situation might relate to their inexperience with the learning environment, so familiarizing themselves with the environment might take longer.

Based on the findings, it can be revealed that properly and attractively designing the animation-based package with an appropriate teaching strategy can achieve success. This result implies that individuals with ID can successfully perform DL skills independently when provided with adequate intervention. This finding parallels the literature, which emphasizes that individuals with special needs, need effective teaching materials, strategies, and techniques (Sulaimani & Bagadood, 2022). Many studies in the literature have shown that CAI is a critical component of educational success in a particular education context (Ayres & Cihak, 2010; Goo et al., 2016, 2019; Ivey et al., 2015; Kang et al., 2021; Smith et al., 2017), which is considered necessary for individuals with ID, due to the challenges they face in learning, concentrating, and communicating (Rose et al., 2005) stem from deficits in verbal reasoning and short-term memory (Quill, 1997). In the literature, there have been limited studies on animation-based video instruction for the learning improvement of individuals with ID (e.g., Çakmak & Çakmak, 2015; Fujisawa et al., 2011; Geçal & Eldeniz Shepherd, 2012; Yeni et al., 2020). Thus, this study contributed to the existing CAI knowledge base by presenting the findings of animation-based instruction with a direct instruction model.

Limitations

The current study has limitations that should be acknowledged. One of the limitations is the small sample size of only three cases, which makes it difficult to generalize the results to a larger population. Therefore, further studies with larger sample sizes are needed to provide more evidence-based practices regarding the efficacy of the teaching package for individuals with ID.

Another limitation of the study is its internet dependency, as the animation-based teaching package was delivered through a web-based platform. This may limit the accessibility of the package for individuals with limited internet access. Future studies may address this limitation by developing mobile applications that can be accessed offline, which could increase the availability and accessibility of the teaching package for individuals with ID and their families.

Overall, while this study provides important insights into the potential benefits of animation-based instruction for individuals with ID, further research is needed to understand its effectiveness better and to develop more accessible and flexible approaches to teaching using this technology.

Implications

The results suggest that adequately designed animation-based packages and appropriate teaching strategies can lead to successful learning outcomes for individuals with ID. This reinforces the need for educators to consider incorporating animation-based instruction as part of their teaching approach when working with individuals with special needs.

The development of the animation-based package in this study is an essential advantage for educators and families working with individuals with ID. The standardized nature of the teaching approach ensures that individuals with special needs receive consistent and practical instruction, regardless of practitioner-based limitations. This can ultimately lead to better learning outcomes and increased independence for individuals with ID.

Future studies can build upon the findings of this study by developing new animation-based learning environments that can support unique education curricula and improve a wide range of skills for individuals with different disabilities. By exploring different approaches to animation-based instruction and developing new packages that target specific learning goals, educators and researchers can continue to refine their understanding of how best to use this technology to support the needs of individuals with special needs. The findings of this study provide an essential foundation for further research in this area and highlight the potential benefits of incorporating animation-based instruction into unique education curricula.

Statements of Publication Ethics

Researchers' Contribution Rate

The first author was responsible for literature review, designing on the environment, and writing the article. The second and third authors were responsible for implementing the study and data gathering. All three authors equally contributed to designing the research and discussing the findings.

Conflict of Interest

The authors declare no potential conflicts of interest.

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