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Technological Tools in Education: Actionbound Experience of Prospective Biology Teachers

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This study aims to analyse the experiences and perspectives of prospective biology teachers regarding their excursions using Actionbound to learn about plant species. The participants in the study consist of 30 undergraduate prospective biology teachers. The focus is on the prospective teachers' enjoyment of the Actionbound experience, the duration to complete the excursion, their willingness to engage in another task-based game, and their views on implementing mobile device-supported biology teaching, specifically related to the design of a biology lesson using Actionbound. The prospective biology teachers predominantly found their experience with Actionbound enjoyable. Their perspectives centred on the App's usability in education and its technical usability. Results show that biology lesson designed with mobile devices positively impacts knowledge retention, motivation, interest, and enjoyment. The results underscore the importance of designing learning environments for effective biology education and teacher training.

Keywords: Actionbound, Mobile Learning, Plant Blindness, Prospective Teachers

Introduction

The ever-expanding global population inevitably leads to the encroachment upon natural habitats and the diminishing of green spaces. The dwindling diversity of plant species, essential even in pharmaceutical production,

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presents a pressing concern in the realm of healthcare, a fundamental necessity. This predicament is dire as reducing plant varieties jeopardizes our food reservoirs and threatens the loss of our verdant landscapes. Hence, plants stand as indispensable cornerstones for all vital ecosystems. As aptly noted by Clary and Wandersee (2011), 'Human existence is intricately intertwined with plants, providing essential sustenance, shelter, clothing, and the very air we breathe.' This emphasizes the urgency to accord greater significance to plants, given the declining biodiversity alongside escalating human demands.

'The majority of us exhibit a greater inclination towards animals rather than plants' (Flannery, 1991). According to Wandersee (1986), this assertion vividly encapsulates the atmosphere that greets any biology educator initiating a lesson steeped in botanical content (Pany & Heidinger, 2017). Obstacles to botanical education have persisted since the 1900s. The enduringly tepid enthusiasm for plant sciences, spanning from primary education to university levels, has remained a subject of enduring discourse among biology pedagogues (Tunnicliffe & Ueckert, 2007). Substantial inquiries into student proclivities (Sjøberg & Schreiner, 2010) validate the lack of allure students perceive in plants. Moreover, surveys conducted in various studies have indicated students' preference for learning about animals, citing greater difficulty in retaining botanical knowledge (Schussler & Olzak, 2008; Wandersee, 1986).

Before the term 'plant blindness' emerged in 1999 (Wandersee & Schussler, 1999, 2001) , this phenomenon had already begun to be recognised as a serious issue in botanical education (Greenfield, 1955; Hershey, 1993, 1996). The inclusion of botanical knowledge, plant species, and the roles of plants in biological life cycles in educational curricula within biology is often acknowledged (Hershey, 1993; Zani & Low, 2022). One of the reasons behind the prevalence of plant blindness is how botanical science content is both learned and taught in schools (Hershey, 1996). Therefore, to make botanical science content more engaging for students, greater effort should be invested in addressing the role of plants in educational processes with a keen emphasis, aiming to render them more captivating within instructional frameworks.

Future educators, who will pass on the most accurate information to future generations, should exemplify by acquiring fundamental knowledge about botany, which shapes vital necessities, understanding their surroundings more intimately, and applying this foundational knowledge in their daily lives. Consequently, educators equipped with botanical education need to implement effective learning approaches and methods to enhance their students' awareness and understanding of plants.

The rapid influx of modern media into educational settings has become an integral part of students' daily lives (Crompton et al., 2016). Regarding plants, a study by Balas and Momsen (2014) indicates that the combination of auditory

and visual information leads to deeper and more meaningful learning about plants, thereby increasing interest in plant science. Mobile devices are typically used during collaborative learning activities, fostering social interaction and communication among students (Patten et al., 2006; Sharples et al., 2002). The use of mobile devices not only supports student-centred learning but also facilitates learning independent of geographic location, hence offering significant opportunities for outdoor learning (Zurita & Nussbaum, 2004).

In the realm of "Mobile Learning," there exists a significant trend blending the distribution of on-site information with the engaging elements of gamified learning. Through the incorporation of GPS technology to relay spatial coordinates via mobile internet services, information access has transcended the traditional boundaries of classrooms and libraries, becoming accessible from nearly all modern smartphones. The smartphone, initially designed primarily for telephony, has morphed into a versatile reservoir of mobile information. Its successful application across diverse educational contexts underscores its effectiveness and hints at potential innovations within educational methodologies.

The process of digitization in education has rapidly advanced with the onset of the pandemic, which began affecting the entire world and ushered in a period termed the 'new normal' following the detection of the first COVID-19 case in Türkiye in March 2020, leading to profound changes in lifestyles. Due to the pandemic, all schools transitioned to full-time remote education as a mandatory measure. The new normal has transformed digital tools and resources in education from being merely preferences or necessities to becoming a requirement, compelling individuals of all age groups to quickly adapt to this process (Tılıç, 2020). Indeed, as part of e-learning, mobile learning, as highlighted by Georgiev et al. (2013), is contingent upon teachers accepting and embracing these technologies, as stated by Menzi et al. (2012). They emphasize that the use of mobile devices for educational purposes and the preference for mobile learning environments are interconnected with the acceptance and adoption of these technologies by educators. In this respect, the opinions of future biology teachers, who are envisioned to impart the science and this perspective to students, regarding mobile learning considered the future of education, and biology topic applications conducted through mobile devices, hold significance.

In this study, a brief task-oriented game focusing on plants was implemented outdoors using mobile devices. The study's main objective is to examine prospective teachers' perspectives concerning using a short task game via the Actionbound mobile application in outdoor plant learning processes. Within this framework, prospective teachers' views regarding mobile learning in conjunction with outdoor tasks and the effectiveness of the Actionbound

application in plant-related subjects were identified.

Research Problem

1. In how many minutes did prospective biology teachers complete the short task game through Actionbound?

2. Did prospective biology teachers enjoy the short tour conducted using their smartphones?

3. What are the preferences of prospective biology teachers regarding playing another game through Actionbound?

4. What are the opinions of prospective biology teachers regarding the excursion conducted with Actionbound?

5. What are the desires of prospective biology teachers, when they become teachers in the future, regarding delivering any topic in biology with mobile device support?

6. What are the views of prospective biology teachers on designing a mobile device-supported biology course?

7. What are the opinions of prospective biology teachers regarding the mobile device-supported presentation of plant species?

Method

This study employed a case study design, a qualitative research method that embraces an interpretative approach to examining the research problem based on an interdisciplinary holistic perspective. In qualitative research, phenomena and events under investigation are considered within their context and interpreted in terms of the meanings attributed by individuals Altunışık et al. (2005). A case study aims to present findings related to a specific situation Yıldırım and Simsek (2018). Consequently, qualitative studies designed with this method necessitate achieving a profound understanding of the subject matter Neuman (2012).

Participants of Study

In this research, convenience sampling, a purposeful sampling method, was employed. In convenience sampling, the researcher selects a situation that is easily accessible, thereby enhancing the speed and practicality of the research process (Patton, 1987; Yıldırım & Simsek, 2018). The study group comprised

30 prospective biology teachers studying at the undergraduate level in biology education at a state university in Ankara. Participant characteristics are presented in Table 1.

Table 1

Distribution of Participant Characteristics.

		f	%
Grade Level	2	8	26.6
	3	16	53.3
	4	6	20
Whether they have taken the course 'Botanical Laboratory' during their undergraduate studies	Yes	22	73.3
	No	8	26.6
Gender	F	26	86.6
	M	4	13.3
The duration of time spent on a smartphone throughout the day	Less than 1 hour	1	3.3
	1-3 hours	9	30
	3-5 hours	17	56.6
	More than 5 hours	3	10

Table 1 shows that 26 of the prospective biology teachers (86.6%) are female, while 4 (13.3%) are male. Among them, 16 (53.3%) are in the 3rd year, 8 (26.6%) are in the 2nd year, and 6 (20%) are in the 4th year. A majority of them have taken the "Botanical Laboratory" course (22 individuals, 73.3%). Regarding their phone usage, 17 participants (56.6%) spend approximately 3-5 hours on their phones daily, while 9 (30%) spend 1-3 hours, 3 (10%) spend more than 5 hours, and 1 (3.3%) spends less than 1 hour per day.

Data Collection Tool

In the study, a semi-structured interview form developed by the researchers was utilized. The interview form consisted of questions related to personal information (gender, class level, whether the prospective teachers had previously taken a botany laboratory course, and approximately how many hours per day they used their smartphones) and inquiries concerning biology education through mobile devices during a short excursion using Actionbound.

Four questions were directed to prospective biology teachers ('Would you like to play another game designed via Actionbound?', 'In the future, when you become a teacher, would you like to teach any biology topic using mobile device support? Please explain your reasons.', 'Could you share your thoughts on conducting this short excursion with the 'Actionbound' application?', 'Do you think a biology class supported by mobile devices could be designed? Could you share your thoughts on this topic?').

Actionbound Setup

At the campus of the state university where the study is conducted, there are numerous representations of Ankara's plants. Currently, botanical laboratory courses for prospective biology teachers are already conducted through outdoor field trips. Within this context, we aimed to have prospective biology teachers test an outdoor short task game related to plants using Actionbound.

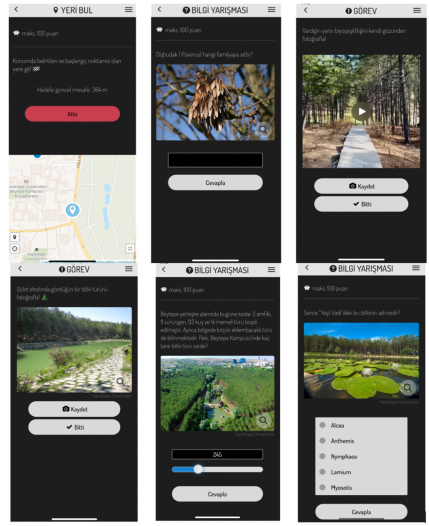

Figure 1. Short Tasks Prepared Via Actionbound.

The Actionbound application operates compatibly with mobile devices, allowing users to create interactive activities that can be downloaded from application stores and used on mobile devices. Hence, participants' smartphones were preferred as the mobile device of choice. To engage in the activities through the application, prospective teachers were directed to the task game initially designed, either through the QR code of the created bound or via 'nearby' bounds (GPS) available on the application.This mobile

application includes quiz functions, immediate feedback, multimedia content, and tasks involving photos and videos (Figure 1). Consequently, the content of this short task game comprises sounds, graphics, images, texts, and videos.

Data Collection Process

At the outset of the study, prospective teachers were introduced to the Actionbound application, outlining the purpose of the study and providing an overview of the steps included within the bound. Prospective teachers downloaded the application onto their smartphones. Subsequently, within the application, they utilized the 'nearby' feature to identify the campus bound. For those unable to identify it, the QR code of the bound was shared. The prospective teachers expressed curiosity about the starting point of the task game, prompting the provision of subtle hints to guide them. The initial step of the game involved locating the starting point and navigating there via a map. The second step entailed identifying and photographing the 'Fraxinus' tree amidst the trees at the starting point. For the third step, they were required to provide the family of Fraxinus as a short-answer response. Moving to another point on the campus was the fourth step, and their location led them up a slope towards the campus pond, where they were asked to capture the biodiversity present in the adjacent forest through their photography. The fifth step necessitated reaching the pond and photographing any plants they could identify around it. In the sixth step, based on the visual of the Water Lily (Nymphaea) on the pond, they were tasked with identifying this plant species and marking it from among the options. This brief task game conducted within the campus area lasted approximately 15 minutes. Following the excursion, the 'Actionbound Application Opinion Form,' developed by the researchers, was administered to 30 prospective biology teachers who voluntarily agreed to participate in the study through face-to-face interviews. The data collection process took about 10-15 minutes, with each student dedicating approximately half an hour to the study. The obtained data were transferred to digital format using Microsoft Office Word 2020.

Data Analysis

In this study, prospective biology teachers' thoughts on the short excursions conducted via Actionbound and the data obtained through the semi-structured interview form regarding the teaching of biology topics using mobile devices underwent descriptive and content analysis, commonly used qualitative data analysis methods. In descriptive analysis, the obtained data can be organized around the themes posed by the research questions, identified, and supported, if necessary, with quotes (Özdemir, 2010). The names of prospective teachers

are not mentioned in the quotes and are expressed as PT1, PT2, etc. In content analysis, the aim is to reach concepts and relationships that can explain the collected data. While descriptive analysis summarizes and interprets the data, content analysis involves a deeper processing of the data, revealing concepts or themes that may not have been noticed initially (Yıldırım & Simsek, 2018).

Reliability

To minimize bias in content analysis, the dataset was analysed by two researchers. In the analysis of qualitative data, the reliability formula proposed by Miles and Huberman (1994) was utilized (Reliability = Agreement / (Agreement + Disagreement)), and the level of agreement between coders was determined to be 85.1%

Results of the Study

Prospective Biology Teachers' Completion Times for the Task Game Applied via Actionbound

The representation regarding the completion times of the task game applied by prospective biology teachers through Actionbound is shown in Table 2. Prospective biology teachers spent an average of 23 minutes and 31 seconds on Actionbound.

Table 2

Distribution Of Time Spent By Prospective Teachers On Actionbound.

Participants	Duration
Participant 1	16 minutes 42 seconds
Participant 2	17 minutes 20 seconds
Participant 3	18 minutes 32 seconds
Participant 4	18 minutes 42 seconds
Participant 5	19 minutes 7 seconds
Participant 6	20 minutes 37 seconds
Participant 7	20 minutes 54 seconds
Participant 8	21 minutes 13 seconds
Participant 9	21 minutes 30 seconds
Participant 10	21 minutes 35 seconds
Participant 11	21 minutes 49 seconds
Participant 12	21 minutes 56 seconds

Continued on next page

Table 2 continued

Participant 13	22 minutes 7 seconds
Participant 14	22 minutes 40 seconds
Participant 15	23 minutes 1 seconds
Participant 16	23 minutes 31 seconds
Participant 17	23 minutes 38 seconds
Participant 18	23 minutes 49 seconds
Participant 19	23 minutes 51 seconds
Participant 20	23 minutes 59 seconds
Participant 21	24 minutes 3 seconds
Participant 22	24 minutes 13 seconds
Participant 23	24 minutes 22 seconds
Participant 24	24 minutes 35 seconds
Participant 25	24 minutes 50 seconds
Participant 26	25 minutes 18 seconds
Participant 27	25 minutes 21 seconds
Participant 28	25 minutes 29 seconds
Participant 29	25 minutes 39 seconds
Participant 30	25 minutes 44 seconds

Opinions of Prospective Biology Teachers Regarding Whether They Enjoyed the Short Excursion Conducted with Smartphones

The opinions of prospective biology teachers regarding whether they enjoyed the short excursion conducted with smartphones are presented in Table 3.

Table 3

Distribution of Opinions on Enjoying Short Excursion with Actionbound .

Enjoyment of the Short Excursion with Actionbound	**f**	**%**
Yes	19	63.3
No	1	3.3
I don't know	10	33.3
Total	30	100

The majority of participants (19 persons, 63.3%) reported enjoying the short excursion with Actionbound, while some (10 persons, 33.3%) remained undecided, and only 1 person (3.3%) indicated not enjoying it (See Table 3).

Prospective Biology Teachers' Desire to Play Another Game via Actionbound

The distribution of prospective biology teachers' willingness to play another game via Actionbound is presented in Table 4.

Table 4

Distribution of Opinions on Prospective Biology Teachers' Desire to Play Another Game with Actionbound.

Prospective Biology Teachers' Desire to Play Another Game with Actionbound	f	%
Yes	19	63.3
No	1	3.3
I don't know	10	33.3
Total	30	100

Many participants (19 persons, 63.3%) reported being willing to play another task game via Actionbound, while some (10 persons, 33.3%) remained undecided, and only 1 person (3.3%) indicated not wanting to play (See Table 4).

Opinions of Prospective Biology Teachers Regarding the Excursion Conducted Through Actionbound

The distribution of opinions of prospective biology teachers regarding the short excursion they conducted with Actionbound is presented in Table 5.

This section presents findings on codes related to the opinions of prospective biology teachers about the short excursion conducted with Actionbound, along with the themes developed accordingly. According to this, in the qualitative analysis, 8 codes have been grouped under 2 themes (See Table 5). Codes such as 'retention', 'attention-grabbing', 'motivation', and 'enjoyment' are categorized under the theme of 'App's usability in education,' while codes such as 'ease of use/understandable,' 'diverse question types of content,' 'information content,' and 'innovative' are grouped under the theme of 'App's technical usability.

Table 5

The Distribution Of Opinions Of Prospective Biology Teachers Regarding The Excursion They Conducted With Actionbound App.

Theme	Code	f	%
App's Usability In Education	Retention	7	16.2
	Attention	10	23.2
	Motivation	10	23.2
	Enjoyment	26	60.4
Total		43	100
App's Technical Usability	Ease of Use / Understandable Content	6	11.7
	Diverse Question Types Content	4	7.8
	Information Content	23	45
	Innovative	18	35.2
Total		51	100
Overall Total		94	100

The statements highlighting the opinions of prospective biology teachers regarding the short excursion they conducted on campus with Actionbound are as follows:

PT3: *'Actionbound explained all the stages and provided us with an enjoyable excursion.'*

PT10: *'Actually, it was a place on campus that I knew well, but I hadn't previously roamed around observing it from this perspective. I liked that.'*

PT14: *'It was a fun and instructive excursion; I won't forget the Hornbeam tree asked in the task game.'*

PT17: *'It made me aware of familiar places from this perspective.'*

PT25: *'It was quite enjoyable to both wander and learn.'*

PT29: *'It's an application in a different and unique concept; I enjoyed using it.'*

Prospective Teachers' Desires, When They Become Teachers in the Future, to Narrate Any Topic in Biology with Mobile Device Support

The distribution of prospective biology teachers' desire to conduct mobile device-supported lessons when they become teachers in the future is presented in Table 6.

Many participants (25 persons, 83.3%) stated that they would be able to

Table 6

The Distribution Of Prospective Biology Teachers' Desire To Conduct A Mobile Device-Supported Lesson When They Become Teachers In The Future.

Teachers' Desire To Conduct A Mobile Device-Supported Lesson	f	%
Yes	25	83.3
No	1	3.3
I don't know	4	13.3
Total	30	100

present a biology topic with mobile device support when they become teachers in the future, while some (4 persons, 13.3%) remained undecided, and only 1 person (3.3%) indicated that they would not teach a biology topic supported by mobile devices (See Table 6).

Prospective Biology Teachers' Views on Designing a Biology Lesson Supported by Mobile Devices

The distribution of prospective biology teachers' views on designing a biology lesson supported by mobile devices is presented in Table 7.

This section presents findings consisting of codes representing prospective biology teachers' views on teaching a biology topic using mobile devices when they become teachers in the future, along with themes developed accordingly. Accordingly, in qualitative analysis, 8 codes have been categorized under 2 themes (Table 7). Upon reviewing the table, codes such as 'animation,' 'visual,' 'video,' and 'audio recording' (58%) fall under the design theme, while codes such as 'fluid models,' 'cell biology,' 'pollination of plants,' and 'human anatomy and physiology' (42%) are categorized under the content theme.

The statements highlighting the opinions regarding the design of a biology course supported by mobile devices for prospective biology teachers are as follows:

PT1: *'Of course, it can be used. We are in the age of technology, and when everything is at our fingertips, this ease and these opportunities should be utilized.'*

PT7: *'It can be structured, thus making participation in the class more active.'*

PT11: *'It can be structured, and even the permanence of knowledge and motivation*

Table 7

The Distribution Of Prospective Biology Teachers' Views On Designing A Biology Lesson Supported By Mobile Devices.

Theme	Code	f	%
Design	Animation	6	10.3
	Visual	23	39.6
	Video	25	43.1
	Audio recording	4	6.9
Total		58	100
Content	Fluid models	2	4.7
	Cell Biology	5	11.9
	Pollination of plants	15	35.7
	Human anatomy and physiology	20	47.6
Total		42	100
Overall Total		100	100

regarding that subject can be provided with mobile devices.'

PT19: *'It can be used in biology topics to increase sensitivity to the environment and biodiversity.'*

PT23: *'In out-of-school learning environments, a biology teaching supported by mobile devices can be designed.'*

PT28: *'Many biology topics need to be concretized. For this reason, biology subjects can be explained using animation and video-supported mobile device usage.'*

Prospective Biology Teachers' Views on the Mobile Device-Supported Presentation of Plant Species

The distribution of prospective biology teachers' views on the mobile device-supported presentation of plant species is presented in Table 8.

This section contains findings consisting of codes representing prospective biology teachers' views on the presentation of plant species supported by mobile devices in the future, along with themes developed accordingly. Accordingly, in qualitative analysis, 8 codes have been categorized under 2 themes (Table 8). Upon reviewing the table, codes such as 'taking photos,'

Table 8

The Distribution Of Prospective Biology Teachers' Views On The Mobile Device-Supported Presentation Of Plant Species.

Theme	Code	f	%
Learning plant species with mobile devices	Taking photos	4	8.3
	Recording videos	2	4.1
	Watching videos	18	37.5
	Fieldwork with mobile devices	24	50
Total		48	100
Learning plant species by doing, experiencing	Fieldwork	15	28.8
	Trips (various out-of-school environments)	7	13.4
	Making observations	29	55.7
	Laboratory work	1	1.9
Total		52	100
Overall Total		100	100

'recording videos,' 'watching videos,' and 'field trips with mobile devices' (48%) fall under the theme of learning plant species with mobile devices, while codes such as 'field trips,' 'excursions (various out-of-school learning environments),' 'making observations,' and 'laboratory work' (52%) are categorized under the theme of learning plant species by doing, experiencing.

The statements emphasising the opinions of prospective biology teachers regarding the mobile device-supported presentation of plant species are as follows:

PT5: *'Using mobile devices to identify, photograph, and verify plant species ensures the permanence of knowledge.'*

PT9: *'In terms of concretizing abstract knowledge, mobile devices can be used in teaching plant species and organs.'*

PT15: *'A student cannot learn plant species permanently without touching and observing plants. Therefore, mobile devices can only be supported by being in the field and making observations.'*

PT20: *'After conducting the lesson using traditional methods, mobile devices can be used to increase permanence.'*

PT27: *'With mobile devices, just as we complete this short excursion, plant species*

can be learned by making observations.'

PT30: *'Teaching plant species with mobile devices can be enjoyable and memorable through interactive games.'*

Discussion

In this study describing the experiences of prospective biology teachers with Actionbound concerning the learning of plant species and their associated opinions, the results indicate that prospective biology teachers primarily engaged in a recent excursion via the Actionbound application, completing it on average in approximately 23 minutes (Table 2). This finding illustrates the time taken by prospective biology teachers to complete the excursion by making observations of plant species and the time spent on the created content tasks within a class period. According to this data, Actionbound as a mobile application for teaching botanical topics could allow for the design, addition, or modification of different and new tasks.

Additionally, opinions regarding the enjoyment derived from this short excursion conducted by prospective biology teachers using their smartphones are presented in Table 3. While the majority expressed enjoyment from this brief excursion, some remained undecided. This viewpoint could be interpreted as a reflection of prospective biology teachers' positive attitudes toward technology-enhanced learning, coupled with their uncertainty about the extensive integration of technology in education. Similarly, upon examining Table 4, many prospective biology teachers expressed their willingness to engage in another game via Actionbound, while some remained undecided. The hesitancy expressed by prospective teachers may be considered in the findings as an indication that the rapidly evolving technological pedagogical methods associated with the digitization of future education might have triggered individual concerns among participants. On the other hand, Borsos et al. (2023) highlighted the significant role of field studies in enhancing individuals' plant recognition skills. Kissi and Dreesmann (2018) suggested that the use of digital tools in out-of-school learning environments could also be an effective method.

When examining Table 5, prospective biology teachers considered the short excursion they conducted with Actionbound under the themes of 'App's usability in education' and 'App's technical usability.' Accordingly, under the theme of 'App's usability in education (43%),' the predominant emphasis was on 'enjoyment (60.4%)', followed by comprehensive reflections on 'attention (23.2%)', 'motivation (23.2%)', and 'retention (16.2%)'. In their research, Sung and Mayer (2013) concluded that there is no significant difference between mobile learning and traditional learning; however, they found that mobile learning enhances student motivation. This illustrates

that prospective teachers discern how positive impacts on students can be achieved in technology-enhanced education through appropriate methods. Indeed, students utilizing the opportunities provided by technology-enhanced applications can learn at their own pace, unlike traditional education. This allows students in self-directed learning to conduct research and guide their study process (students can research and guide themselves (Delil, 2017).

When examining the views of prospective biology teachers on whether they will use mobile device-supported teaching for a biology topic when they become teachers (Table 6), it is evident that they predominantly hold positive thoughts about using mobile devices (83.3%). However, 13.3% of prospective biology teachers indicated being undecided on this matter. This indicates that prospective teachers are aware of the necessity of integrating technology into teaching methods, considering it as a requirement of the era we live in. Küçükali and Coşkun (2021) stated that the use of technology in education, interest in coding and robotics applications, the digitalization of printed books or forms through web 2.0, and even communication through various mobile applications necessitate digital leadership in this direction. The desire of prospective teachers to design a biology lesson supported by mobile devices in the future (Table 6) aligns with the rapidly progressing digitization process in education and the desire, as stated by Menzi et al. (2012), to integrate mobile learning into instructional environments.

Moreover, in the study, the opinions of prospective teachers on designing a biology lesson supported by mobile devices were categorized into ”design” and ”content” aspects. Under the ”design” theme, the predominant viewpoint highlighted the potential support of ”video (43.1%).” This viewpoint was followed by comprehensive perspectives favouring content design supported by ”visual (39.6%),” ”animations (10.1%),” and ”audio recordings (6.9%).” This finding signifies notable perspectives indicating that mobile applications can enhance students’ attention to various subjects. Furthermore, the capabilities provided by mobile devices allow students to easily access information anytime and anywhere Ireland and Woollerton (2010).

Within the theme of ”content (42%),” the prevalent viewpoint emphasizes the potential for mobile device-supported instruction in topics related to ”human anatomy and physiology (47.6%).” This is followed by considerations for ”pollination in plants (35.7%),” ”cell biology (11.9%),” and ”fluid models (4.7%).” This finding highlights the inclination of prospective teachers to make abstract biology concepts more tangible. Several reasons have been proposed for the abstract nature of these subjects, including teachers’ heavy reliance on textbooks, the prevalence of lectures detached from practical application, the perception of biology as a memorization-heavy subject, and the fear of failure among individuals (Akpınar, 2006; Tekkaya et al., 2000).

When examining Table 8, the views of prospective biology teachers on the mobile device-supported teaching of plant species are categorized under the headings 'Learning plant species with mobile devices (48%)' and 'Learning plant species by doing, experiencing (52%)'. Under the theme 'Learning plant species with mobile devices', there is a predominant viewpoint on 'fieldwork with mobile devices (50%)'. Numerous designed and implemented programs emphasize the importance of plants in schools (e.g., 'PlantingScience' www .plantingscience.org or 'Biological Sciences Curriculum Study - BSCS' ww w.bcsc.org). These programs cover a range of activities, from plant growth observation programs (Hershey, 1993, 1996) to field trips investigating plant diversity (Dillon et al., 2006; Drissner et al., 2010; Fančovičová & Prokop, 2010; Vaughan et al., 2003). These activities have been specially designed to make plant science more engaging for students, including activities like classifying plants (Frisch et al., 2010; Lindemann-Matthies, 2005; Randler, 2008). Therefore, positive outcomes have been achieved in increasing students' awareness of plants through such interactions (Kristi et al., 2021). Additionally, outdoor education not only enhances knowledge about plant species but also positively influences attitudes toward plants (Fančovičová & Prokop, 2010). This viewpoint is followed by the perspectives of 'watching videos (37.5%)', 'taking photos (8.3%)', and 'recording videos (4.1%)'. Accordingly, prospective biology teachers have emphasized that teaching plant species with mobile devices can be designed with various task stages such as taking photos, recording videos, watching videos, or conducting these practices in the field. This aligns with our study's aim regarding the willingness of prospective teachers to implement various task stages in teaching plant species with mobile devices and their enjoyment (Table 3), as well as their desire to engage in another game (Table 4). All these opinions are a reflection of the creative learning and teaching approaches they possess for more effective botanical instruction when they become teachers in the future.

Conclusions

The findings from the study indicate that future educators enjoy teaching topics using Actionbound and are predominantly eager to play another designed game and, when they become teachers, to predominantly design biology topics supported by mobile devices. Additionally, they completed the designed short game approximately at the same time. Considering these results, alongside the design of a lesson using mobile devices for effective botanical teaching, it is imperative to encourage future educators to integrate these applications into their classes. Moreover, this application should not only be considered for effective botanical education but also serve as a perspective for prospective teachers that task game design through mobile applications can be imple-

mented across various biology topics.

According to the results, prospective teachers have expressed opinions that teaching biology with mobile devices could have a positive impact on "retention," "interest," "motivation," and "enjoyment" of learning. Simultaneously, they have articulated various opinions regarding the technical usability of Actionbound, acknowledging its "explanatory and understandable" interface, ability to design tasks with "various question types," and its "innovative" approach. Considering the prevalent role of smartphones in our lives today, harnessing the use of mobile devices in education, transforming them into educational benefits, and increasing interest and motivation, can only be achieved through various technological pedagogical tools like Actionbound. Prospective teachers believe this technological approach will be effective, particularly in subjects that remain abstract and have lower memorability, such as "human anatomy and physiology," "pollination in plants," "cell biology," and "fluid models." Furthermore, prospective teachers exhibit creative thinking concerning the design of a biology topic via a mobile application (such as animation, video recording, audio recording, and photography). Moreover, while stating that experiential learning with plant species is effective, prospective teachers suggest that botanical lessons could be designed within the scope of a mobile device-supported field study. These field studies have expressed multifaceted ideas, such as field trips and various excursions (such as museums, and science centres), conducting observations (such as in natural forests), and laboratory work. These opinions reflect the expectations of prospective teachers, even as students, for learning more effectively about plant species in botanical classes.

Recommendations

The recommendations drawn from the study are outlined below:

a) Based on all these outcomes, expanded task-based gaming content, integrated into lesson durations and content using various technological pedagogical tools, could be developed for the effective use of mobile devices in education.

b) For effective botany education, diverse and varied tasks can be integrated to design different Actionbounds within the task-based mobile learning framework.

c) Informing prospective biology teachers about the potential of designing biology topics with mobile device support, demonstrating how these technologies can be used both inside and outside the school environment to make lessons more engaging.

d) Transferring the potential of using mobile devices in education to prospective biology teachers through pre-service and in-service training sessions.

e) Diversifying the botanic topics by designing various task-oriented games on platforms like Actionbound, enabling future biology teachers to apply these and obtain feedback on their effectiveness.

f) Enhancing the comprehensibility of topics like human anatomy and cell biology by designing tasks through Actionbound that address the abstract aspects of these subjects.

g) Implementing botanic courses adaptable to outdoor settings through technology integration and mobile device support within biology teacher education programs at higher education institutions.

References

Akpınar, E. (2006). *Computer support in structuring abstract concepts in science teaching: The electricity unit that directs our lives.* Unpublished doctoral thesis, Dokuz Eylül University, Izmir..

Altunışık, R., Çoşkun, R., Bayraktaroğlu, S., & Yıldırım, E. (2005). *Research methods in social sciences, 4th edition*. Türkiye: Sakarya.

Balas, B., & Momsen, J. L. (2014). Attention "blinks" differently for plants and animals. *CBE: Life Sciences Education*, *13*(3), 437-443. https://doi.org/10.1187/cbe.14-05-0080

Borsos, E., Bori□, E., & Patocskai, M. (2023). What can be done to increase future teachers' plant knowledge. *Journal of Biological Education*, *57*(2), 252-262. https://doi.org/10.1080/00219266.2021.1909632

Clary, R. M., & Wandersee, J. H. (2011). A "Coprolitic Vision" for earth science education. *School Science and Mathematics*, *111*(6), 262-273. https://doi.org/10.1111/j.1949-8594.2011.00087

Delil, S. (2017). Use of mobile devices as educational materials: Contribution of properly designed mobile education applications to learning. *International Journal of Social Sciences and Education Research*, *3*(1), 200-207.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2006). The value of outdoor learning: Evidence from research in the UK and elsewhere. *School Science Review*, *87*(320), 193-200.

Drissner, J., Haase, H. M., & Hille, K. (2010). Short-term environmental education - Does it work? - An evaluation of the 'Green Classroom. *Journal of Biological Education*, *44*(4), 149-155. https://doi.org/10.1080/00219266.2010.9656215

Fančovičová, J., & Prokop, P. (2010). Development and initial psychometric assessment of the plant attitude questionnaire. *Journal of Science Education and Technology*, *19*(5), 415-421. https://doi.org/10.1007/s10956-010-9207-x

Flannery, M. C. (1991). Considering plants. *The American Biology Teacher*, *53*(5), 306-309. Retrieved from https://www.jstor.org/stable/pdf/4449303.pdf

Frisch, J. K., Unwin, M. M., & Saunders, G. W. (2010). *Name that plant! overcoming plant blindness and developing a sense of place using science and environmental education*. Netherlands: Springer.

Georgiev, T., Georgieva, E., & Smrikarov, A. (2013). M-learning-a new stage of e-learning. In *International conference on computer systems and technologies-compsystech* (Vol. 4, p. 1-4).

Greenfield, S. S. (1955). *The challenge to botanists.* Retrieved from https://secure.botany.org/plantsciencebulletin/psb-1955-01-1.php

Hershey, D. R. (1993). Plant neglect in biology education. *BioScience*, *43*(7), 418. https://doi.org/10.2307/1311898.

Hershey, D. R. (1996). A historical perspective on problems in botany teaching. *The American Biology Teacher*, *58*(6), 340-347. https://doi.org/10.2307/4450174

Ireland, G. V., & Woollerton, M. (2010). The impact of the iPad and iPhone on education. *Journal of Bunkyo Gakuin University Department of Foreign Languages and Bunkyo Gakuin College*, *10*, 31-48. Retrieved from https://www.bgu.ac.jp/assets/old/center/library/image/fsell2010_031-048.pdf

Kissi, L., & Dreesmann, D. (2018). Plant visibility through mobile learning? Implementation and evaluation of an interactive Flower Hunt in a botanic garden. *Journal of Biological Education*, *52*(4), 344-363. https://doi.org/10.1080/00219266.2017.1385506

Kristi, B., Parsley, K. M., & Sabel, J. L. (2021). An Analysis of Plant Awareness Disparity within Introductory Biology Textbook Images. *Journal of Biological Education*. https://doi.org/10.1080/00219266.2021.1920301

Küçükali, R., & Coşkun, H. C. (2021). Digitalisation in Education and the Place of Artificial Intelligence in School Management. *International Journal of Leadership Studies: Theory and Practice*, *4*(2), 124-135. Retrieved from https://dergipark.org.tr/en/download/article-file/1483237

Lindemann-Matthies, P. (2005). 'Loveable' mammals and 'lifeless' plants: How children's interest in common local organisms can be enhanced through observation of nature. *International Journal of Science Education*, *27*(6), 655-677. https://doi.org/10.1080/09500690500038116

Menzi, N., Nezih, Ö., & Çalışkan, E. (2012). Examining academicians'

opinions on the use of mobile technologies for educational purposes within the framework of the technology acceptance model. *Journal of Aegean Education*, *13*(1), 39-55.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.

Neuman, W. L. (2012). *Social research methods: Quantitative and qualitative approaches. i-ii. volume (5th edition)* (and others, Ed.). Istanbul: Publishing Room.

Özdemir, M. (2010). Qualitative data analysis: A study on the problematic of methodology in social sciences. *Eskişehir Osmangazi University Journal of Social Sciences*, *11*(1), 323-343. Retrieved from https://dergipark.org.tr/en/download/article-file/113287

Pany, P., & Heidinger, C. (2017). Useful plants as potential flagship species to counteract plant blindness. In and others (Ed.), *Cognitive and affective aspects in science education research: Selected papers from the esera 2015 conference* (p. 127-140). Springer International Publishing.

Patten, B., Sanchez, I. A., & Tangney, B. (2006). Designing collaborative, constructionist and contextual applications for handheld devices. *Computers and Education*, *46*(3), 294308. https://doi.org/10.1016/j.compedu.2005.11.011

Patton, M. Q. (1987). *How to use qualitative methods in evaluation (no. 4)*. Sage.

Randler, C. (2008). Teaching species identification-A prerequisite for learning biodiversity and understanding ecology. *Eurasia Journal of Mathematics*, *4*(3), 223-231.

Schussler, E. E., & Olzak, L. A. (2008). It's not easy being green: student recall of plant and animal images. *Journal of Biological Education*, *42*(3), 112-119. https://doi.org/10.1080/00219266.2008.9656123

Sharples, M., Corlett, D., & Westmancott, O. (2002). The design and implementation of a mobile learning resource. *Personal and Ubiquitous Computing*, *6*, 220-234. https://doi.org/10.1007/s007790200021

Sjøberg, S., & Schreiner, C. (2010). *The ROSE project. An overview and key findings.* Retrieved from https://www.uv.uio.no/ils/english/research/projects/rose/publications/the-rose-project.pdf

Sung, E., & Mayer, R. E. (2013). Online multimedia learning with mobile devices and desktop computers: An experimental test of Clark's methods-not-media hypothesis. *Computers in Human Behavior*, *29*(3), 639-647.

Tekkaya, C., Çapa, Y., & Yılmaz, Ö. (2000). Misconceptions of prospective biology teachers about general biology subjects. *Hacettepe University Journal of Education*, *18*, 140-147. Retrieved from https://hdl.handle.net/11511/88274

Tılıç, G. (2020). The concept of gamification within the scope

of digitalization in education. *Journal of Art and Design*, *26*, 671-695. Retrieved from https://dergipark.org.tr/en/download/article-file/1473633

Tunnicliffe, S. D., & Ueckert, C. (2007). Teaching biology-the great dilemma. *Journal of Biological Education*, *41*(2), 51-52. https://doi.org/10.1080/00219266.2007.9656061

Vaughan, C., Gack, J., Solorazano, H., & Ray, R. (2003). The effect of environmental education on schoolchildren, their parents, and community members: A study of intergenerational and intercommunity learning. *The Journal of Environmental Education*, *34*(3), 12-21. https://doi.org/10.1080/00958960309603489

Wandersee, J. H. (1986). Plants or animals: Which do junior high school students prefer to study. *Journal of Research in Science Teaching*, *23*, 415-426. https://doi.org/10.1002/tea.3660230504

Wandersee, J. H., & Schussler, E. E. (1999). Preventing plant blindness. *The American Biology Teacher*, *61*(2), 82-86. https://doi.org/10.2307/4450624

Wandersee, J. H., & Schussler, E. E. (2001). Towards a theory of plant blindness. *Plant Science Bulletin*, *27*(1), 2-9. Retrieved from https://www.botany.org/bsa/psb/2001/psb47-1.html

Yıldırım, A., & Simsek, H. (2018). *Qualitative research methods in social sciences (11th edition* (and others, Ed.). Retrieved from https://hdl.handle.net/11511/70532

Zani, G., & Low, J. (2022). Botanical priming helps overcome plant blindness on a memory task. *Journal of Environmental Psychology*, *81*.

Zurita, G., & Nussbaum, M. (2004). Computer supported collaborative learning using wirelessly interconnected handheld computers. *Computers & Education*, *42*(3), 289-314. https://doi.org/10.1016/j.compedu.2003.08.005