Table S1. kano questionnaire details.

Indicators of user needs	Forward Issue
Plant Growth Environment Monitoring and Data Analysis Function（P1）	Do you think it's awesome that the little screen on the teaching aids immediately shows how much water the plant has drunk and how much sun it has gotten?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Plant Growth Environment Regulation（P2）	This plant teaching aid can regulate its own temperature and humidity so that the plant is always in the most comfortable environment, don't you think this is super awesome?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Intelligence Level (e.g., automatic data logging, data storage and sharing)（P3）	Do you find it convenient that the teaching aids can automatically record the plant's daily growth data and share it with the teacher and classmates?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Cloud-based integration and remote teaching support（P4）	Wouldn't it be fun to observe plant growth remotely and have lessons with your fellow school teachers even at home?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Interactive teaching features, such as touch operation or simple games（P5）	This teaching aid can be operated by touch, and you can also play small games related to plants, learning while playing.
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Plant Classification and Identification Teaching Module（P6）	There's a special module on the teaching aids that helps you recognize all the different plants, it's like having a little dictionary of plants, do you think it's useful?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Simple plant physiology experiments（P7）	This teaching aid allows you to do some simple plant physiology experiments and experience first-hand how plants grow, just like a little scientist, do you feel like it?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Easy to Operate（P8）	This teaching aid is particularly easy to operate, children will know it at a glance, and do not need to be taught by the teacher for a long time, do you think it is very convenient?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Modular design adapts to diverse classroom layouts（P9）	The small parts of this plant teaching aid can be easily disassembled and reassembled for use at home, school or outdoors - do you think that's flexible?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Portability and Durability（P10）	This teaching aid is very lightweight, but also particularly strong, children carry it around is not easy to break, do you think it is durable?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。

Easy to clean and maintain（P11）	The teaching aids are easy to clean, dirty with a damp cloth, and simple to maintain, do you think it's hassle-free?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Plant Life Cycle Display（P12）	This teaching aid can completely show the whole process of plants from seed to blossom and fruit, it's like watching a movie of plant growth, do you think it's intuitive?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Learning Content Sustainability（P13）	The learning content of this teaching aid will be constantly updated, so you can always learn new plant knowledge without getting bored, do you find it attractive?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Closely Aligned with Elementary Science Curriculum Standards（P14）	This teaching aid is designed according to the elementary school science curriculum standards to help you learn better from the textbook, do you find it helpful?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Adapted for Different Cognitive Levels（P15）	This teaching aid can provide different levels of difficulty according to the different cognitive levels of children, as if customized, do you think it is sweet?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Guiding Independent Learning and Inquiry（P16）	This teaching aid will give you some hints and guidance to explore the mystery of plant growth on your own initiative, just like a little explorer, do you find it interesting?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Provide User Feedback and Customized Services（P17）	This teaching aid collects feedback on your usage and also provides customized learning content based on your needs, just like an exclusive learning partner, do you think it's good?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Scalable to accommodate new teaching modules（P18）	This teaching aid can add new teaching modules to learn more about different plants in the future, it's like a growing treasure trove of learning, do you think it has potential?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Display instructional usage time（P19）	This teaching aid shows you how long you've been using it, like a little timer, do you think it's practical?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。

Indicators of user needs	Reverse Issue
Plant Growth Environment Monitoring and Data Analysis Function（P1）	How would you feel if the teaching aids wouldn't show how much water the plant drank or how much sun it got and you had to guess?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Plant Growth Environment Regulation（P2）	Do you think it would be bad if the teaching aids had no way to regulate temperature and humidity and the plants had to rely on their surroundings?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Intelligence Level (e.g., automatic data logging, data storage and sharing)（P3）	Would you find it a hassle if the teaching aids didn't automatically record data and you had to write it manually every time, and you couldn't share it?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Cloud-based integration and remote teaching support（P4）	Would you see any impact if the teaching aids weren't cloud-linked, couldn't be taught remotely, and could only be used at school?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Interactive teaching features, such as touch operation or simple games（P5）	If the teaching aids don't have touch operation and game function, and you can only look and listen to them, do you feel that something is missing?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Plant Classification and Identification Teaching Module（P6）	How would you feel if the teaching aids didn't have a plant classification and identification module and you had to read the book to recognize the plants yourself?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Simple plant physiology experiments（P7）	Would you find it uninteresting if teaching aids couldn't do plant physiology experiments and you could only look at them but not do them?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Easy to Operate（P8）	What do you think would be the problem if the teaching aids were complicated to operate and difficult for children to learn?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Modular design adapts to diverse classroom layouts（P9）	What would you find inconvenient if the teaching aids were in one piece and could not be disassembled and could only be fixed in one place for use?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Portability and Durability（P10）	How would you feel if the teaching aids were heavy and breakable, and the kids had a hard time holding them and breaking them?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Easy to clean and maintain	If teaching aids are hard to clean, hard to get dirty, and a pain in the ass to maintain, do you get a headache?

（P11）	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Plant Life Cycle Display（P12）	If the teaching aids could only show part of the plant's growth process and not the full presentation, what would you find lacking?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Learning Content Sustainability（P13）	How would you feel if the learning content of the teaching aids stayed the same and there was nothing new after a few lessons?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Closely Aligned with Elementary Science Curriculum Standards（P14）	What would be wrong with you if the teaching aids didn't match the elementary science curriculum standards and the learning was different from the textbook?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Adapted for Different Cognitive Levels（P15）	What impact do you think it would have if the teaching aids had only one difficulty level and were not suitable for children of different cognitive levels?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Guiding Independent Learning and Inquiry（P16）	How would you feel if the aids didn't guide you and you had to rely on the teacher to talk and you had no way to actively learn on your own?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Provide User Feedback and Customized Services（P17）	What would you find inconvenient if the teaching aids could not collect feedback or provide customization, but only uniform learning?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Scalable to accommodate new teaching modules（P18）	What limitations would you feel if you couldn't add new modules to your teaching aids and had limited learning content?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。
Display instructional usage time（P19）	If the teaching aids don't show the time of use and you don't know how long you've been learning, what impact do you think it would have?
	Like it□，Should be expected□，Indifferent□，Tolerable□，Dislike□。

Table S2. User interview questions.

Subject	Interview content
T3	During the trial of the teaching aids, which features (e.g. interface layout, operation flow, physical buttons, etc.) do you think best meet your learning/teaching needs??
	During the trial of the teaching aids, do you think there is any room for improvement?
T7	How long did it take you to get the tool to work independently? What features (e.g. guided tutorials, hint pop-ups) accelerated the learning process?
	During the independent exploration phase, were there any features that hindered learning due to poor design? How do you think it could be optimized to shorten the learning cycle?
T1	What are the core reasons for frequent use of this teaching aid in future teaching?
	In which learning/teaching phases (e.g., new lesson introduction, experimental manipulation, review and consolidation) will you use the teaching aid with high frequency?