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Effectiveness of a Hybrid Online Teaching Methodology in Delivering Home Horticulture Education During the COVID-19 Pandemic

Abstract

A hybrid home gardening program was delivered to New Jersey residents through a series of synchronous and asynchronous presentations. Pre and post tests indicated that students demonstrated significant knowledge gain in covered topics. Respondents to a feedback survey administered after program completion reported being very satisfied with both the educational material and the learning management system (LMS) and reported self-assessed knowledge gain due to participation. Respondents reported behavioral changes and reported that the online hybrid programming format provided convenience and flexibility to meet their learning needs.

Abbreviations: LMS - Learning Management System

Keywords: Online education; home horticulture; Master Gardener; learning management system; hybrid method of instruction

Introduction

Home horticulture programs have traditionally been delivered locally through in-person classroom sessions. During COVID-19, the public responded by staying home and following CDC social distancing guidelines (Fernandez and Shaw, 2020). In some places, in-person programming was restricted by university mandates necessitating transitioning education to virtual formats.

Concurrently, a rise in the interest of gardening suggested an increased need for horticultural programming (Kinzler, 2020; Walljasper and Polansek, 2020; Werlin, et al., 2020). For example, the University of Nebraska–Lincoln reported a 50% increase in viewership to its long-running *Backyard Farmer* gardening show (Kinzler, 2020). Similarly, the University of Minnesota reported double to triple the usual number of home garden inquiries (Kinzler, 2020). In New Jersey, there was anecdotal evidence supporting similar trends.

The challenges presented by the pandemic were not new to Extension. The literature is replete with articles discussing the use of emerging technologies to enhance program delivery (Allred and Smallidge, 2010; Dromgoole and Boleman, 2006; Rich et al., 2011). These technologies were used to diversify audiences, provide flexibility, expand educational outreach to underserved audiences, while expanding program reach beyond geographic boundaries. Web-based program delivery gained popularity due to its efficiency in reaching a growing clientele base, while providing similar educational benefits to in-person delivery (Allred and Smallidge, 2010; Dromgoole and Boleman, 2006; Rich et al., 2011). This manuscript will discuss the results of the Rutgers Gardening Education Series, a collaborative program delivered in response to challenges imposed by the COVID-19 pandemic.

Methods

The Rutgers Gardening Education Series was implemented in 2021 as a multi-county, cooperative program targeting home horticultural clientele. The program was modeled

on a county hybrid Master Gardener training program that combined in-person and web-based delivery methodologies.

Each weekly module covered one of the 16 recommended core competency areas associated with the Rutgers Master Gardener curriculum of a two-hour live presentation and accompanying resources including fact sheets, web-links, videos and other related resources. In addition, 10 elective modules were provided. These modules were delivered asynchronously via a combination of pre-recorded presentations, videos and other content. Students were provided access to materials throughout the entirety of the course. Individual county coordinators conducted local online synchronous discussion sessions wherein students could interact directly with other students.

The Canvas LMS (Instructure, Salt Lake City, UT) was utilized to ensure efficient program delivery and uniformity. Students received training and support on using the LMS from their local coordinator. Tools were used to facilitate student interactions, including polling questions to stimulate audience participation and gauge students' understanding.

Pre and post tests were administered to quantify students' knowledge gain. The test consisted of 24 questions related to the course content.

Following completion of the program, a feedback survey was administered to quantify student satisfaction in the delivery method, and to determine the level of change in practices employed. A modified Dillman's methodology was utilized, with the survey being emailed to all registered students, followed by a reminder email at the conclusion of the program period, and a final reminder email 30 days after the program completion.

Statistical methods

Results for demographic questions from respondents to the feedback survey were compared to demographic data from New Jersey as a whole (USCB, 2021) with exact multinomial and binomial tests (Mangiafico, 2016a). Pre and post ratings for self-assessment of knowledge gain was compared with a Wilcoxon–Mann–Whitney test (Mangiafico, 2016b). The proportion of correct answers for each question for the pre

test and post test were compared with paired *t* test. Distributions of the differences of these paired proportions were checked for approximate normal distribution.

Statistical analyses were conducted in R (R Core Team, 2021) with the *stats*, *XNomial*, and *rcompanion* packages. Figures were designed in R with the *ggplot2* package or in Canva (Canva, Surry Hills, NSW, Australia).

Results and Discussion

Program students

The program was well attended with 156 students from 15 counties in New Jersey and one adjoining county in Pennsylvania participating. This program was the first Extension educational program that a majority (77%) of respondents had attended. Additionally, when respondents were asked how knowledgeable they were about Rutgers Cooperative Extension programs, 38% reported no knowledge, while only 15% reported having knowledge. Top reasons reported for enrolling in the program were to better understand problems in their garden (75%), to increase knowledge of growing vegetables (61%), and to learn more about pruning, ornamental plants, and tree and small fruit (57%, 54%, and 39%, respectively).

Demographics

Considering responses from the feedback survey (n = 65), a majority of respondents were female (75%), between 35 and 64 years of age (62%), and self-identified as white (83%) (Table 1). Responses for racial categories varied significantly from those in New Jersey as a whole (p = 0.001), with statistically fewer responses for “Asian” (p = 0.002), but with no statistical differences for the “Black”, “White”, or “Two or more” categories (p > 0.05). Responses were significantly lower for “Hispanic or Latino” ethnicity than for NJ (p = 0.0004), were significantly higher for “Female” gender than for NJ (p < 0.0001) and were significantly higher for “Age 65 or older” than for NJ (p = 0.002). Eighty-nine percent reported having an undergraduate or graduate degree, and responses to the survey were significantly higher for “Bachelor’s degree or higher” for education than for

NJ ($p < 0.0001$). These results are similar both to traditional gardening programs in New Jersey and to those reported by Dorn et al. (2018) and Schrock et al. (2000).

Effectiveness of the method of instruction

When asked to describe their current work situation, 43% of respondents indicated that they were retired and not working while 13% reported being retired and working part time. Many of the students (28%) reported working full-time. This is a large percentage when compared to other Extension gardening programs which reported higher percentages of retirees and lower reports of employment (Dorn et al., 2018). The large percentage of students with full or part time employment may be a contributing factor in the acceptance of the online delivery method. For example, a majority (53%) reported that they would not have been able to participate in the program if it were offered during daytime hours, while 62% of respondents reported that the online delivery "somewhat" or "very much" impacted their ability to participate. Further, 74% reported that online delivery increased their likelihood to participate regardless of the COVID-19 pandemic and any associated restrictions. One plausible explanation for the high level of acceptance may be the convenience that the online format provided to students. The combination of both synchronous and asynchronous delivery provided students more flexibility to meet their individual learning needs. Rost and VanDerZanden (2002) also reported that ease of participation and convenience were both significantly correlated to students' willingness to take additional online courses.

Survey respondents were asked questions to evaluate the LMS as a tool for educational program delivery. In assessing the ease of use of the LMS, 89% of respondents reported being able to access all content, 10% reported some difficulty using the LMS, leaving 1% that reported no use. When asked to select specific attributes of the LMS that were useful to students, 39% identified the ability to view presentations or learn at their own pace, while 22% identified the ability to choose resources based on individual interests as primary benefits. The reported acceptance and effectiveness of teaching technologies by Extension clientele, as well as their support in use by Extension educators, have been reported to be important considerations when developing online programming (Dromgoole and Boleman, 2006; Rich et al., 2011). The acceptance of the

LMS may be attributed to the high level of education represented by the respondents to the survey and their willingness to engage in new teaching methods. Rost and VanDerZanden (2002) reported a significant correlation between college education level and acceptability of the online learning experience.

Program effectiveness

Program effectiveness and self-assessed knowledge gain

Respondents to the feedback survey reported that the program met their expectations with 93% of respondents rating the program as “good”, “very good”, or “excellent”.

Retrospective knowledge assessment by students showed a significant increase in the level of horticultural knowledge (z = –4.97, p = < 0.0001, Cliff’s *delta* = –0.478, 95% confidence interval: –0.634, –0.319) with numerical increases in the “advanced” and “very advanced” categories and numerical decreases in the “beginner”, “novice”, and “intermediate” levels (Figure 1).

Adoption of approved practices

Students reported an increase in their implementation of Extension recommended practices based on what they had learned in the course. Top practices reported included using science-based factsheets (66%), making better plant selections (61%), changing pruning practices (43%), finding science-based resources (39%), and taking a soil test (39%) (Figure 2). The reported impacts of the program were realized beyond the students with 93% of respondents reporting that they shared the information learned during the program with others. These reported changes in practices suggest that online program delivery may be a useful tool to deliver educational programs and to maximize the impact of Extension programming efforts.

Table 1. Selected demographic results from respondents from a feedback survey for a gardening education series (*n* = 65) and for New Jersey as a whole (USCB, 2021).

Demographic Category	**Current Study (%)**	**New Jersey (%)**
Race		
Asian	0	10
Black	11	15
White	83	72
Two or more	0	2
Some other	0	- [*]
Prefer not to respond	6	-
Ethnicity		
Hispanic or Latino	5	21
Not Hispanic or Latino	88	-
Prefer not to respond	8	-
Gender		
Female	75	51
Male	20	-
Prefer not to respond	5	-
Age		
18–34	3	-
35–64	62	-
65 or over	32	17
Prefer not to respond	3	-
Education		
Bachelor's degree or higher	89	40

[*] -, Data not available from this source.

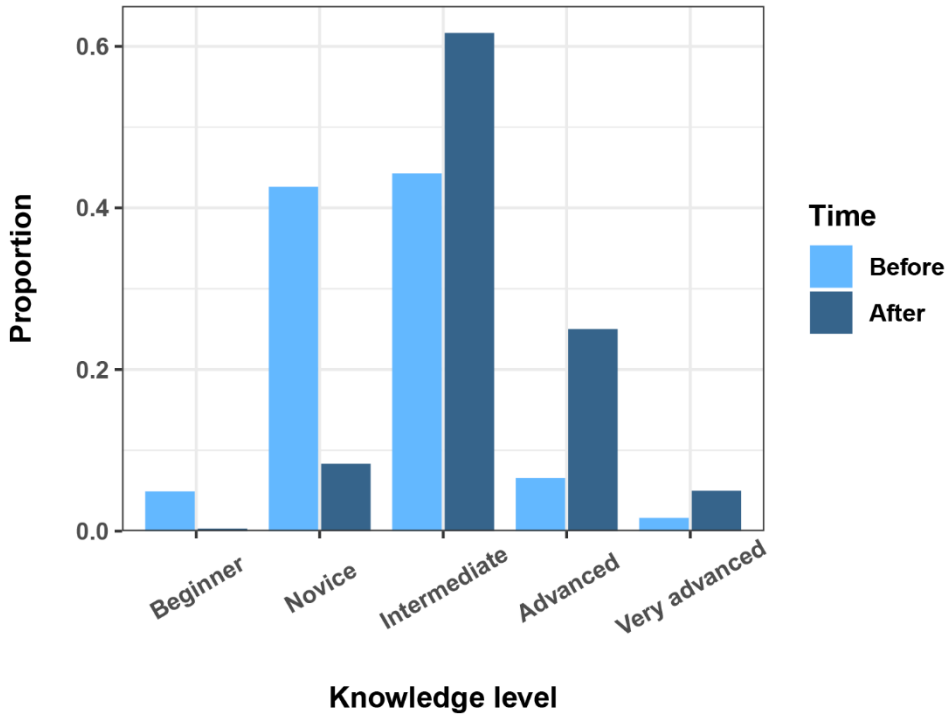

Figure 1. Knowledge level responses of covered topics for a retrospective self-assessment from a gardening education series (*n* = 61).

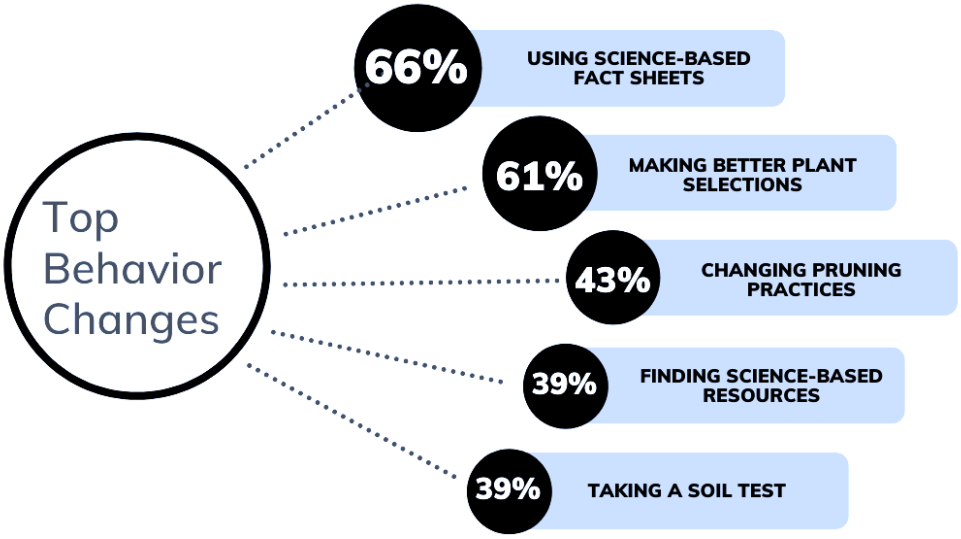

Figure 2. Select changes in behavior following participation in a gardening education series as reported by program students.

Pre and post knowledge tests

There was a notable difference in the number of respondents in the pre test (n = 111) and the post test (n = 22), partially stemming from the fact that not all participating counties required completion of these tests. It is not known if there was self-selection where more confident students were more likely to complete the post test, which would bias the post test results.

A significant increase in the proportion of correct responses was found between responses for the pre test and the post test, (t = 3.7, df = 23, p = 0.001). The mean increase in the proportion of correct responses was 13% (0.13, 95% confidence interval: 0.06–0.20). Questions with the largest increase in the proportion of correct responses had topics of compost requirements for carbon and nitrogen (Δ = 50%), organic pesticides being considered pesticides (Δ = 38%), understanding fertilizer grade (Δ = 36%), and best timing for pruning shrubs (Δ = 28%).

Questions with the lowest correct response rates in the post test had topics of the composition of thatch (5% correct), pest resistance of native plants (23%), and conditions required for moss to grow (23%).

The effectiveness of the program delivery method has been cited as being an important consideration when delivering Extension programs (Rich et al., 2011). In the current example, students demonstrated improved knowledge gain following the online program. Although no comparisons were made between the online program and comparable in-class programs, similar reports have demonstrated that students in online programs performed as well as students in traditional classroom instruction (Shulman and Sims, 1999).

Conclusions

Online hybrid educational methods and tools proved to be highly effective in the delivery of Extension programming. From the student's perspective, this resulted in flexibility both in terms of participation and in the ability to learn at their unique pace. Students expressed the benefit of having a sense of autonomy through their ability to further their

knowledge in areas that were of particular interest to them. The online program also allowed participation from non-traditional clientele, in particular those who work during daytime hours or have other responsibilities that limit their ability to participate in a traditional daytime classroom program. The online program allowed for statewide collaboration which enhanced the program's effectiveness by having recognized Extension experts deliver the material in an efficient manner, and at the same time provided an opportunity to reach a more diverse audience with quantified impact.

While this study presents results from one iteration of the course comprising less than one year of instruction, the education program was effect enough to continue in a similar format even as restrictions due to COVID-19 have relaxed.

As Extension program delivery continues to evolve to include online or hybrid offerings, it has the potential to reach new and diverse audiences. The results in this study highlighted the limited demographic reach of this specific program relative to the state population as a whole and invoke a broader question about how Extension programs can ensure reaching an inclusive audience.

Before utilizing these technologies, Extension educators should carefully assess their clientele and determine the teaching delivery method that best aligns with their needs. Online delivery may not be well-suited to all learners and would have limited utility in areas where internet access is limited. Some Extension educational efforts will continue to be best-suited to in-person and one-on-one delivery.

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