Effectiveness of Hunter Education Delivery Methods

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Executive Summary

Purpose- The primary goal of this study was to investigate the impacts of hunter education (HE) delivery methods (virtual-only, in-person-only, and virtual/in-person hybrid) on student preparedness. Two secondary goals were to 1) investigate which aspects of delivery methods were most effective and 2) explore what types of students would benefit from different HE delivery methods.

Background- In the United States, HE is a requirement to participate in most hunting activities. Though HE implementation and methodology vary by state, all states administer a form of HE. Research shows HE participants desire the knowledge and skills taught in HE courses but vary in their preference for HE delivery (see Courtney & Date, 2014). However, little data exists to help states develop HE delivery requirements and polices that incorporate student preferences and new technologies while still resulting in safe, legal, and responsible hunter behavior. This uncertainty regarding delivery methods has resulted in disagreements between and among agency leadership, HE administrators, and HE instructors. Consequently, HE policies have been heavily influenced by anecdotal evidence, administrator opinion, or prevailing assumptions rather than scientifically valid and defensible data.

Approach- Five partnering states were selected to collaborate on this study, based on the HE delivery methods they offer. We collected data on HE **student attributes** (demographics, test scores, satisfaction, attitudes etc.), **course attributes** (length, class size, field day, live fire, etc.), and **instructor attributes** (demographics, tenure, etc.) to compare the outcomes. The primary outcome metrics of this study were student preparedness (as measured by the final test score on a standardized HE exam) and student satisfaction with HE (measured by attitudinal survey questions).

Findings- Each of the three HE delivery methods examined in this study did not meaningfully affect test scores or satisfaction. Test scores did not vary according to prior hunting experience or gender. However, non-white students and students influenced by the most barriers to hunting performed better in, and were more satisfied with, hybrid and virtual HE delivery methods. Instructors who were older or female produced students with higher test scores. HE courses that met for less than 16 total course hours and were administrated in three or fewer sessions produced students with higher test scores. Instruction that included handling firearms and live-fire sessions resulted in increased student test scores. When the gender of instructors and students matched, test scores of females and males remained the same. However, male students learning from female instructors had slightly better test scores and female students learning from male instructors had slightly worse test scores.

Implications-Agencies should consider continuing to provide HE using multiple delivery methods. Because there are little differences in student preparedness and satisfaction between the HE delivery methods examined in this study, specific delivery methods should not be favored over others based upon test scores or student satisfaction. This is particularly true as customers likely self-select into the HE delivery method they are more likely to be satisfied with and that are best suited to their unique needs.

Introduction

Per the 2016 "Review of the Governance and Administration of the International Hunter Education Association - United States of America" completed by the Wildlife Management Institute on behalf of the Association of Fish and Wildlife Agencies,

> "The original mission of the IHEA-USA and its founding organizations has varied slightly over the years but has always reflected the following premise: "To create safe, responsible, and knowledgeable hunters."
> (Hunter Education in the US and Canada with Recommendations for Improvement, 1982)

The premise in this observation is reflected in the most recent edition of IHEA-USA's bylaws (2021) which state that the organization's purpose is "to continue the heritage of hunting worldwide by developing safe, responsible, knowledgeable, and involved hunters. This shall be done by increasing safe and responsible participation in hunting, enhancing the delivery of Hunter Education, improving the professional skills and standing of Hunter Education professionals and volunteer instructors, and enhancing the image of hunters and hunting."

IHEA-USA's current mission closely follows its above stated purpose. Specifically, that IHEA-USA "serves hunting and shooting sports educators worldwide by developing and implementing standards and resources based on research that promote safe, responsible, and ethical practices while fostering partner communication (IHEA-USA 2022-2024 Strategic Plan, 2021)."

Within both the organization's purpose and mission statements are specific charges relative to HE delivery; 1) "enhancing the delivery of Hunter Education (IHEA-USA Bylaws, 2021)," and 2) "developing and implementing standards and resources based on research (IHEA-USA 2022-2024 Strategic Plan, 2021)." Considering that IHEA-USA is, in practice, primarily a member service organization with neither the authority nor capacity to administer, fund, or deliver HE programs within any state, the above charges can only be delivered by assisting its member states with the implementation of their individual HE programs. Thus, common barriers to state HE program delivery and management have generally formed IHEA-USA's primary strategic and action directives (WMI, 2016).

Since the immergence of virtual HE delivery tools and other novel curricula options, one of the most difficult barriers to HE delivery improvement has been the absence of course outcome data capable of illuminating how various HE delivery methods impact student learning outcomes and post-course behaviors. Prior to this study, no HE course evaluation standards existed that were capable of generating course outcome data at state, regional, or national scales. As a result, HE administrators and policy makers have not had access to relevant data to help them determine how to incorporate new advances in online course delivery, whether to reduce or alter minimum course hour requirements, how to diversify

course delivery options for different student demographics, or how to guide recommendations for course deferral standards. These missing data have, understandably, led to uncertainty and disagreements between agency leadership, HE administrators, and HE instructors on how HE delivery should be regulated within state HE programs. Consequently, HE policies have largely been developed using anecdotal evidence, HE administrator opinion, or prevailing assumptions.

If allowed to persist, this lack of unbiased, justifiable, and scientifically-sound HE course evaluation criteria and outcome data is likely to continue causing disparity and disagreement within state HE program standards, and could ultimately threaten inter-state HE certification reciprocity. The importance of IHEA-USA's role in addressing this barrier by generating reliable HE delivery outcome data cannot be overstated. Even a cursory review of IHEA-USA history from its earliest permutations in the 1940's reveals why a scientific, outcome-based approach to hunter education curricula and delivery standards is critical to the long-term legitimacy of state agency-mandated hunter education. Public expectations of safe hunters, reciprocity of hunter certification between states, the defense of hunting as a safe and legitimate activity on multiple-use public lands, and hunting as a valid use of wildlife as a Public Trust resource are arguably all predicated on the ultimate justifiability of hunter education as an effective purveyor of safe, legal, and responsible hunter behavior.

Therefore, it is the hope of the authors that the results and findings of this report can serve to empower state HE administrators to make hunter education more accessible, efficient, and customer friendly while ensuring that in so doing, the ultimate outcomes of hunter education to make safe, legal, and responsible hunters are not sacrificed.

Approach

In an effort to provide data to inform decisions regarding HE delivery methods, project investigators conducted a five-state study, wherein student preparedness and student satisfaction was accessed for HE delivered via virtual, hybrid and in-person methods. In the participating states, HE was delivered using three major implementation categories:

1. **In-person-** HE courses completed all in-person, with no virtual learning elements. Many of these courses included a field day or skills day, though in some states these were not required.

2. **Hybrid-** HE courses that incorporated a virtual learning component (instruction and/or assessment) along with in-person instruction and assessment. Most often, the hybrid delivery method included a virtual curriculum followed by in-person instruction, whether in the classroom, a field/skills day, or both.

3. **Virtual-** HE courses that were taught and assessed entirely online. This projects intersection with the COVID-19 pandemic resulted in a higher than usual number of students enrolled in online-only formats as field days and in-person courses were canceled in some participating states per agency policy.

As is the case in nearly every educational setting, HE uses a final exam score to indicate the student's comprehension of, and competence with, course materials. In the case of HE, states require a student to achieve a passing score to certify that the student is sufficiently —albeit minimally— prepared to conduct themselves safely, legally, and responsibly in the field. Just as these states use the final exam as a surrogate for the preparedness of students, we also used the final test score as an indicator of each student's preparation to participate in the hunting community. Student satisfaction was measured using a series of 5-point Likert-scale survey questions that are standard within the social science assessment field. Instructors were also surveyed to collect data about them, their teaching style, and the classroom environment.

Sample Parameters

Partnering state wildlife agencies in this study were Alabama Department of Conservation & Natural Resources, Florida Fish and Wildlife Conservation Commission, Iowa Department of Natural Resources, Missouri Department of Conservation, and Texas Parks and Wildlife. Alabama, Florida, Iowa, Missouri, and Texas were selected based upon the diversity of their HE delivery methods as well as their capacity to comply with research methodology.

To achieve the research objectives above, three datasets were matched that included 1) final test scores from students, 2) results from HE student attitude and satisfaction surveys, and 3) results from HE instructor surveys (which contained information about the instructor themselves as well as attributes of the HE course they taught). Between August 13 and November 20, 2021, test scores were collected from 24,336 students ($n_{\text{in-person}}$ = 1743, n_{hybrid} = 2143, n_{virtual} = 19622). The most test scores were collected from Missouri (n = 8654), followed by Texas (n = 7393), Alabama (n = 3227), Iowa (n = 2500), and Florida (n = 1000). This study intentionally oversampled test scores in anticipations that response rates on the HE student survey would approximately mirror the industry average ($\approx$ 8-10%).

To ensure consistency across all delivery types (eliminating mode effects), all HE students who were included in this study between August 13 and December 15, 2021 were surveyed electronically (Appendix A). HE students taking hybrid and in-person HE courses were assured that their HE instructor would not see their responses (HE instructors were mandated by their respective state HE coordinator to set aside 10-15 minutes at the end of the course so HE students could take the survey). For students taking HE virtually, a link redirecting to the survey was provided to students upon completion of their final exam. In the five participating states, 3350 HE students completed the survey ($n_{\text{in-person}}$ = 1409, n_{hybrid} = 1437, n_{virtual} = 504), with a response rate of 13.8%, somewhat higher than industry norms. As a result, estimates of HE student attitudes and characteristics have an overall margin of error of ±1.5% (very high statistical certitude) and state-level estimates have margins of error ranging from ±3.6% to ±4.5% (high to acceptable statistical certitude).

During the fall of 2021, 110 instructors completed the instructor assessment survey (Appendix B), providing information about themselves and the attributes of the HE course they taught to participating HE students. Instructors were chosen by state HE coordinators based upon their reliability, quality of instruction, and their ability to be flexible in their instruction to accommodate the research design. Each instructor taught 23 HE students on average. Data from test scores, student surveys, and instructor surveys were matched for 1173 HE students; therefore statistics of HE students' attitudes combined with instructor or course attributes have a margin of error of ±2.78% (high statistical certitude). In some

cases, the high sample size and the resultant high statistical power is problematic because they illuminate relationships that are statistically significant but not meaningful in a practical sense. To solve this issue, we report the findings within the text followed by sample estimate, the test statistic, the significance, and a measure of effect size to give an indication of practical significance. *For example*: Male and female students had the same test scores (M $_{male}$ = 90.8%, M $_{female}$ = 91.0%; *F*=2.76, *p*=0.10, η^2 =.000).

In this report, sample statistics are often given as averages (M) or percentages, and *F*-tests (*F*) are used to test for statistical significance for *t*-tests, ANOVAs, and General Linear Models. Eta-squared (η^2) values are used to indicate the effect size for simple comparisons, and partial eta-squared (partial-η^2) values are used when relationships are being examined while accounting, or controlling, for other confounding variables.

Findings

Main Findings

Students who took HE virtually or in a hybrid format had slightly higher test scores than in-person students (*F*=20.5, *p*<0.001, partial-η^2 =.06). Although the difference was statistically significant, there was little applicable significance between delivery methods (M $_{in-person}$ = 87.1%, M $_{hybrid}$ = 88.8%, M $_{virtual}$ = 89.5%). In practical terms, this means students who completed virtual HE got one more question correct on the final exam than did in-person students (figure 1). There are a number of confounding variables that muddle the relationship between HE delivery methods and test scores. Because of this, we collected data on several confounding variables (such as student age, sex, prior hunting experience, and the state of residence) and included them as covariates to the regression model. This approach is often used as a best practice in statistical analysis when there are variables that may obscure the relationship between two variables of interest. As a result, the confounding effects of these variables are negated, so we can isolate the effects of just HE delivery methods on test scores. Throughout this report, this approach is referred to as 'controlling for' or 'accounting for' confounding variables.
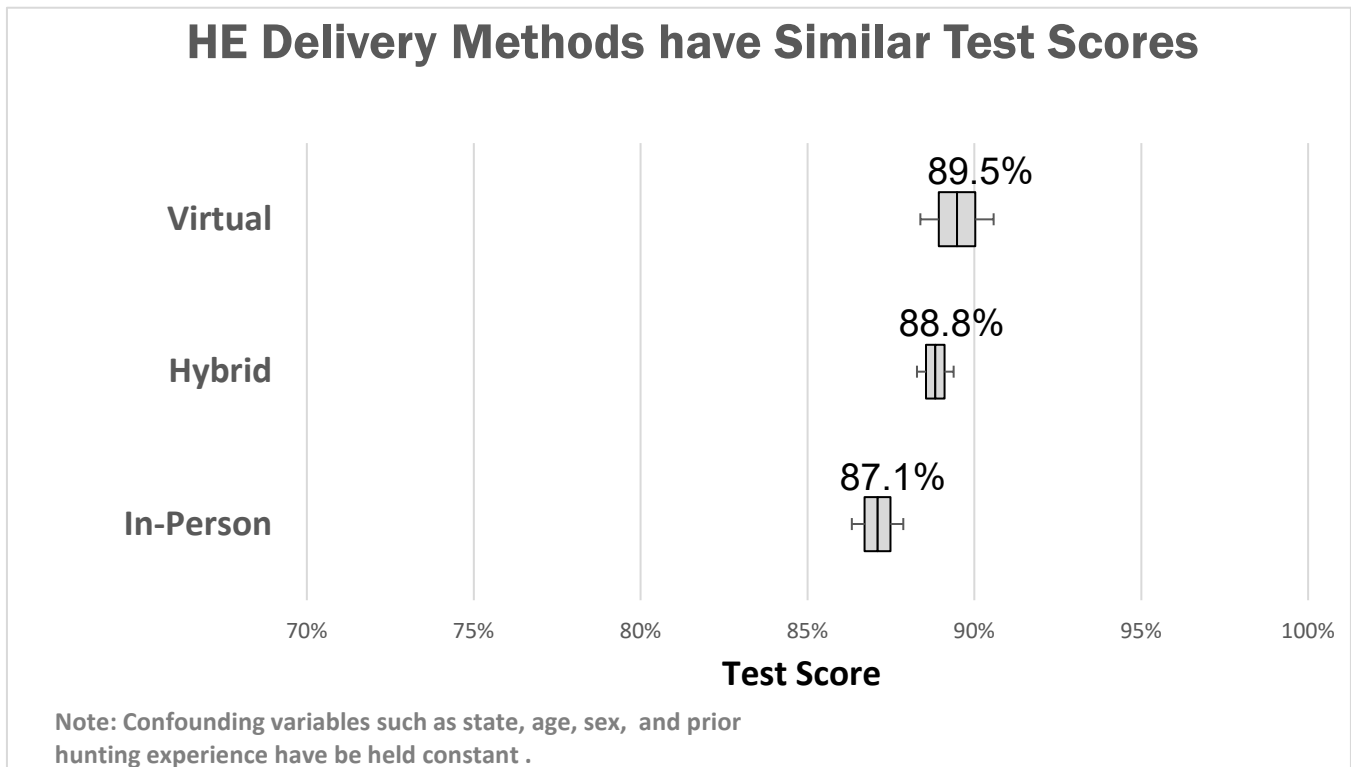
HE Delivery Methods have Similar Test Scores

Figure 1. There were no practical differences in test scores between students who took HE via different delivery methods (F=20.5, p<0.001, partial-η2 =.06).

Students who took HE virtually or in a hybrid format were slightly more satisfied with their HE experience than in-person HE students (F=14.41, p<0.001, partial-η^2 =.04). However, there were no practical differences in satisfaction rates by delivery method (M $_{in-person}$ = 4.40, M $_{hybrid}$ = 4.44, M $_{virtual}$ = 4.47 on a 5-point satisfaction scale). To only examine the relationship between delivery methods and satisfaction with the HE experience, confounding variables (age, sex, prior hunting experience and the state of the HE student) were accounted for during this comparison.

Student-Related Findings

Students enrolled in HE as a part of this study, regardless of delivery method, were mostly male (77%), younger (51% were younger than 21 years of age), and White (72%). The overwhelming majority of HE students were either satisfied or very satisfied (43% and 51%, respectively) with their overall HE experience. Most HE students (94%) passed the final exam with a passing grade of 80% or greater on their first attempt (figure 2). Most students (89%) reported that the HE course was the correct level of difficulty for them. When asked about their preference in learning styles, HE students identified themselves as predominantly kinesthetic (41%), followed by visual (32%), language (13%), or as auditory (12%) learners.
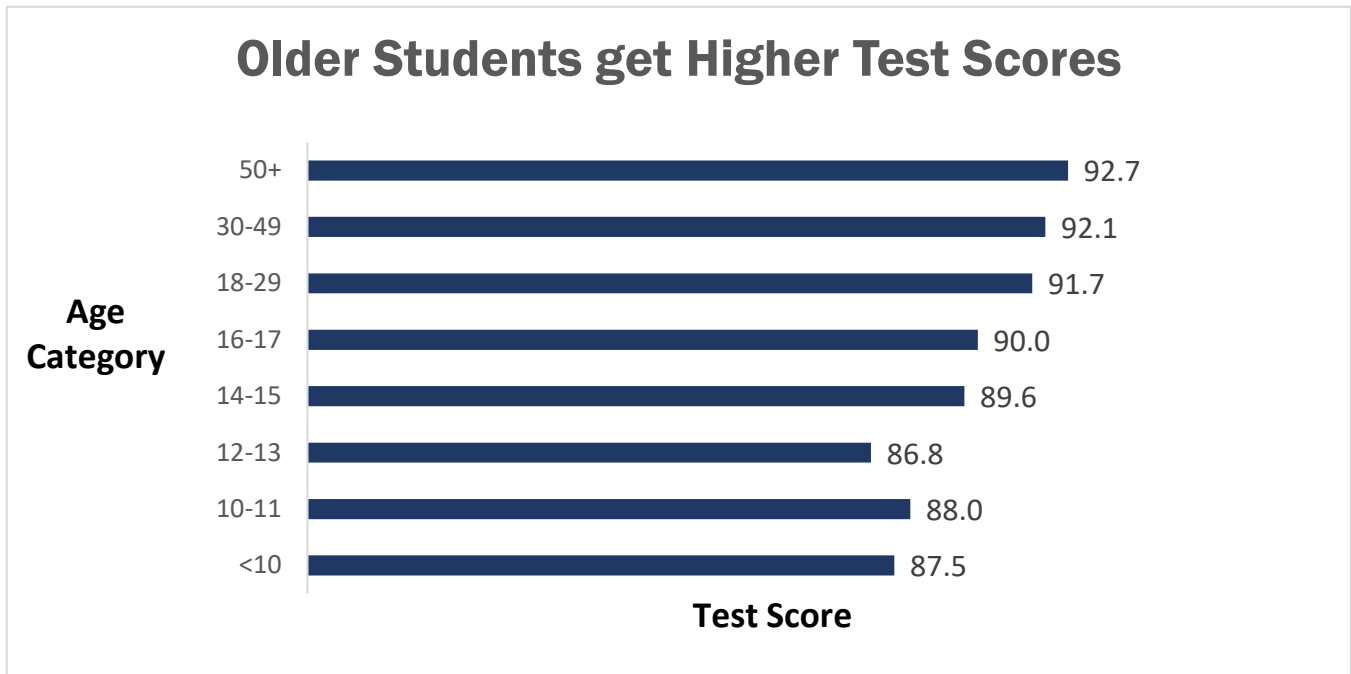
Older Students get Higher Test Scores

Age Category	Test Score
50+	92.7
30-49	92.1
18-29	91.7
16-17	90.0
14-15	89.6
12-13	86.8
10-11	88.0
<10	87.5

Figure 2. Test score generally increase with age until adulthood, at which time scores are about the same regardless of the age of the adult.

Most HE students could already be considered as recruited to hunting. The majority of students had some hunting experience prior to their enrollment in an HE course (71%), and half of HE students had hunted annually or more frequently. The majority of HE students had very high social support for hunting, as 82% of students had immediate family who hunted and 88% of students had extended family who hunted. Further, most HE students (77%) had peers who hunted. Despite this previous experience and social support, very few HE students (11%) reported they had participated in an HE deferral program or apprentice hunting license program and participation in these programs did not appreciably affect HE satisfaction or test scores.

Test scores were analyzed across many aspects of students' background and attitudes. Notable findings include that White, Asian, and Hispanic students had higher test scores than Native American and Black students (F=75.4, p<0.001, η^2 =.016; M_{White} = 91.0%, M_{Asian} = 89.8%, $M_{Hispanic}$ = 89.1%, $M_{NativeAmerican}$ = 84.8%, M_{Black} = 83.3%). Students of different sexes achieved nearly identical scores (F=2.76, p=0.10, η^2 =.000; M_{male} = 90.8%, M_{female} = 91.0%). HE students with more prior hunting experience achieved statistically higher—but not practically higher—test scores than their less-experienced counterparts (F=3.28, p=0.011, η^2 =.007). Adult HE students performed better on the final exam than adolescent HE students (F=946.5, p<0.001, η^2 =.039; M_{adult}=91.9%, M_{child}=89.0%). Additionally, test scores slightly increased with age during adolescence, however scores were nearly uniform during adulthood (F=176.8, p<0.001, η^2 =.05).

Clusters of Students

To better illuminate the relationships between, and implications of, the data collected during this study, it

is useful to explore the results in the context of students groups who share similarities in various aspects such as their backgrounds, attitudes, or behaviors. When we group students with similar characteristics and attributes, these groups are referred to as clusters, and the grouping process is called clustering or cluster analysis. Cluster analysis is a multivariate data mining technique that, in this case, groups HE students based on demographics, final exam score, satisfaction, hunting attitudes, hunting social support, and barriers to continuation in hunting (table 1). In this analysis, there emerged five clusters of HE students, each of which are described below:

Cluster 1	This group was all young, male, and mostly White. This group had extensive personal hunting experience, and had very high family and peer support for hunting. Hunting was more central to their identity and they had fewer barriers to hunting. This group was satisfied with HE and did well on the final exam, particularly in-person.
Cluster 2	This group was all young, male, and mostly White. This group was similar to Cluster 1 in many regards, except they had less experience hunting and their families had less hunting experience.
Cluster 3	This group was very similar to Cluster 2 group except that it was all females who were, on average, two years older. This group had less hunting experience, but had families with more hunting experience. This group had similar test scores in the virtual delivery method, but slightly lower test scores in hybrid and in-person delivery methods.
Cluster 4	This group had more adults, more males, and was less racially homogeneous, and in particular, included more Hispanics students than other clusters. This group had the highest satisfaction with HE, the highest intention to go hunting, and the fewest barriers preventing them from going hunting (likely because this group consisted of more adults who have the resources to overcome such barriers). This group contained many lapsed hunters who are returning to the hunting experience as an adult.
Cluster 5	This group was the most different from all other clusters. This group included the most adults, the most females, and the most persons of color. This group had significantly less personal hunting experience and fewer families who hunt. They had less desire to hunt, less social support to hunt, and face more barriers to hunting than any other group. This group had the lowest satisfaction with HE and the lowest test scores, though this group had significantly better performance in hybrid and virtual delivery methods.

Table 1. Cluster analysis of hunter education students

	Cluster 1 (n=280)	Cluster 2 (n=389)	Cluster 3 (n=256)	Cluster 4 (n=427)	Cluster 5 (n=433)
% Male	100%	100%	0%	91%	75%
% White	98%	98%	96%	90%	81%
% Black	2%	0%	2%	2%	11%
% Hispanic	2%	2%	5%	12%	15%
Age	14.5	14.6	16.7	19.8	19.9
Hunt experience – Personal	4.5	4.1	3.7	4.2	1.8
Hunt experience – Family	4.5	4.3	4.5	4.1	2.3
I want to go hunting in the future	4.8	4.8	4.7	4.9	3.7
My family is supportive of hunting	4.8	4.7	4.7	4.8	3.8
It would be easy for me to go hunting	4.2	4.2	4.3	4.4	3.4
It's likely that I will [hunt in the future]	4.7	4.6	4.5	4.7	3.4
Satisfaction	4.5	4.4	4.4	4.6	4.2
Virtual	89.8	89.3	90.6	91.5	86.5
Hybrid	88.0	90.3	87.4	89.8	86.6
In-person	92.0	92.0	88.7	87.0	82.7

The findings of the cluster analysis is particularly interesting from the perspective of HE delivery methods and the interactions with underrepresented populations. Clusters 1 and 2 (younger, mostly male, White, moderate to high amount of hunting experience and support) tended to perform better in the hybrid and in-person HE courses. To accommodate these constituencies, agencies should consider continuing to offer HE via this delivery method. However, Cluster 5 which had the most females, most persons of color, least experience, least social support, and the most barriers to recruitment performed significantly better in hybrid and virtual courses. Therefore, if agencies are interested in recruiting more females, more persons of color, or those with higher barriers to hunting, agencies should also continue to offer HE virtually and in-hybrid delivery methods.

Instructor-Related Findings

Instructors who participated in this study were mostly male (80%), older (54% were older than 50 years of age), and White (93%). The background of instructors varied, though many came from the education, law enforcement, and natural sciences fields (22%, 17%, and 15% respectively). Instructors in this study were also long tenured in HE (M=13±10 years). Of the instructors who were selected to participate in this research, 54% had only taught in-person classes, 31% had taught only hybrid HE courses, and 16% have taught HE using both delivery methods. HE was most often taught by three instructors or more (36%).

The HE students of female instructors achieved higher test scores (M_{female} = 89.0%; M_{male} = 85.9%, F=9.10, p=0.003, η^2 =.010), but HE students were slightly more satisfied with male instructors (M_{female} = 4.2; M_{male} = 4.4, F=13.17, $p<0.001$, η^2 =.011). In general, students of older instructors achieved higher test scores (F=5.84, $p<0.001$, partial η^2 =.220), even after accounting for tenure of the instructor.

However, the age of HE instructor was not related to student satisfaction. Additionally, the professional background of the instructor had no relationship to the satisfaction of students but did have an impact on the test scores of students. The highest HE student test scores were generated by instructors from the healthcare field (93%), and, to a lesser extent, natural sciences and law enforcement fields (92% and 90%, respectively). Instructors in agricultural vocations had significantly lower test scores (79%), followed by instructors from education and the formal sciences fields (85% and 87%, respectively). These data do not have enough statistical power for agencies to actively seek or exclude volunteer instructors whose professions are from certain fields, but it is enough to warrant further opportunistic investigation.

HE instructors were asked to what extent they use kinesthetic, visual, language, and auditory teaching styles. Results indicated that instructors taught using mainly visual (31%), kinesthetic (22%), auditory (18%), and language (6%) techniques. Because teaching styles are not mutually exclusive, project investigators included descriptions of each teaching style, gave several diagnostic behaviors that are characteristic of each teaching style, and then asked each instructor the extent to which they used the teaching style. The teaching style was measured on a 4-point scale ranging from '*I don't really teach this way*' to '*This is the main way I teach*'. Instructors who responded '*I teach a lot this way, but it is not the main way I teach*' or '*This is the main way I teach*', were categorize as that style of teaching. Instructors with different teaching styles had students with statistically different test scores ($F=6.54$, $p<0.001$, $\eta^2 =.072$). Some general patterns in the data were that instructors who used multiple styles (three or four styles) of teaching seemed to have lower test scores than average. Another interpretation of these data is that those instructors who indicated they teach using three or four teaching styles may not know what teaching styles they use or they actually used all teaching styles, but were not particularly effective in any one style. Further, of instructors who only used one teaching style, those using the visual style of teaching had students with the lowest test scores, and those using the language style of teaching had students with the highest test scores. In general, instructors using the kinesthetic style in combination with another teaching style seemed to generate students with the highest test scores.
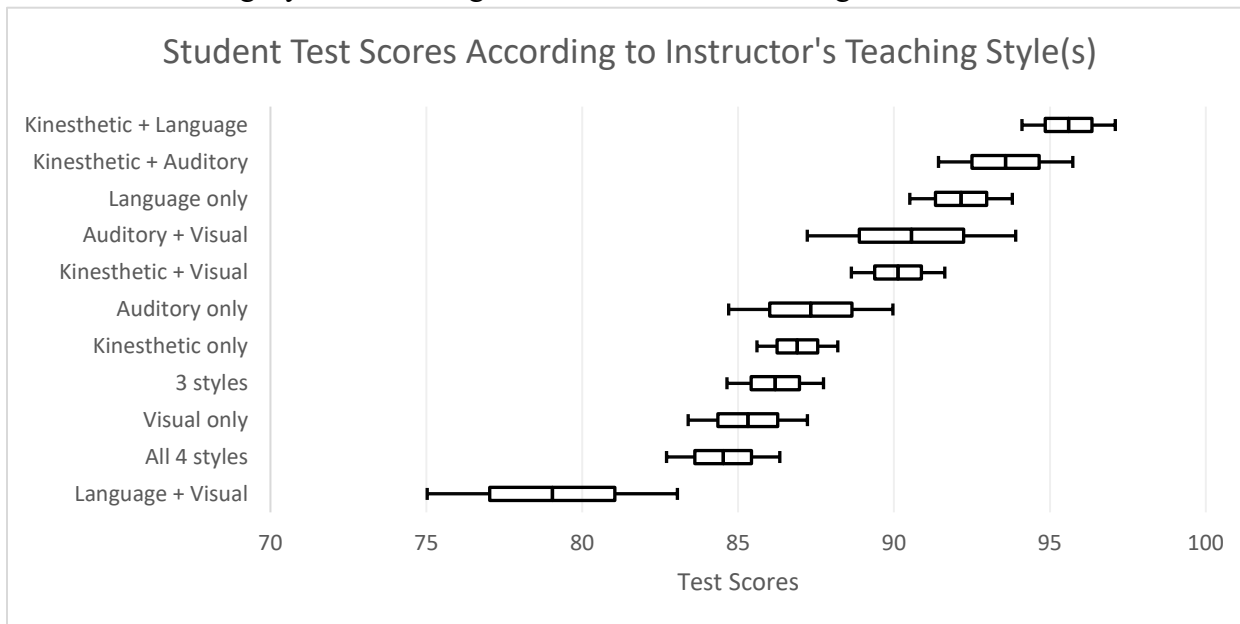

Figure 3. HE instructor's self-identified teaching style had an impact on their students' test scores. *note: these data only include students from in-person and hybrid delivery methods.*

Instructors with different teaching styles had students with statistically different satisfaction levels (F=2.59, p=0.004, η^2 =.022). Most teaching styles had intermediate and similar satisfaction levels (ranging between 4.2 and 4.5 on a 5-point scale), though two outliers contribute to the statistical significance. Specifically, instructors who combined language and visual methods had lower satisfaction (4.06), and kinesthetic and auditory had higher satisfaction (4.63) than the remainder of the teaching methods.

Course-Related Findings

The duration of in-person HE courses (M=11±5 hours) and hybrid courses (M=5±3 hours) examined in this study differed, as would be expected. The course duration was not available for students who took HE virtually. Most (80%) students going through hybrid courses were taught in one-time gatherings on the same day, presumably for a skills day or field day. Conversely, only 29% of students taking in-person courses were taught in one-time gatherings on the same day. More hybrid HE courses had elements of firearms handling than in-person HE courses (84% and 60%, respectively). In similar fashion, more hybrid courses had live-fire instruction than in-person HE courses (56% and 25%, respectively). It should be noted that live-fire requirements varied within and among the states who participated in this study.

For in-person and hybrid HE courses, courses longer than 16 hours generally produced lower test scores. Test scores were fairly consistent for HE courses less than 8 hours, but began to vary more widely after eight hours of instruction. In general, HE classes that included more activity-based instruction had better scores when compared to HE classes that were passive, lecture-based instruction, particularly if the passive instruction was longer than four hours in duration. Student satisfaction with their HE experience was not related to class duration, unless the course exceed 20 hours, after which student satisfaction declined significantly.

For some hybrid and many in-person HE courses included in this study, instructors found it necessary to administer a class in more than one session. Both test scores and student satisfaction were highest when courses were taught in fewer than three sessions, and test scores and satisfaction declined in courses taught in more than four sessions. Because there are no marginal benefits for longer instruction, agencies should consider a standard business practice of HE classes lasting fewer than 16 hours and distributed over fewer than three days.

Very few elements of HE course instruction examined in this study substantially impacted student performance on the final exam. Of those that did, the element that most strongly impacted test scores was the handling of firearms or dummy firearms. The opportunity to handle firearms or dummy firearms raises student test scores four points (F=13.8, p<0.001, partial η^2 =.081), and live fire sessions raise the student test score six points (F=14.8, p<0.001, partial η^2 =.101). Test scores increased seven points if students participated in both firearms handling and live-fire sessions (F=17.5, p<0.001, partial η^2 =.135). Another element of the HE course instruction that impacted scores were student-to-instructor ratios. HE courses with lower student-to-instructor ratios led to improved test scores (F=148.5. p<0.001, r^2=.155). The variance in test scores starts to vary increasingly wider as student-to-instructor ratios exceed 25 students to one instructor. Consequently, HE administrators should consider a standard business practice of hybrid and in-person HE classes to recommend a maximum student-to-instructor ratio of 25:1. Interestingly, handling firearms, live-fire sessions, or student-to-instructor ratios did not influence

satisfaction with the HE experience.

A final element that was impactful to student success on the HE final exam was the combination of the gender of the student and the gender of the instructor (gender-match). The combination of student and instructor gender was statistically significant (F=6.70, p<0.001, η^2 =.023). When the genders of instructors and students matched, test scores were not different from each other (M=86.6%). Male students instructed by females was the student-instructor combination with the highest test scores (M=90%). Conversely, female students being instructed by males was the student-instructor combination with the lowest test scores (M=84%).
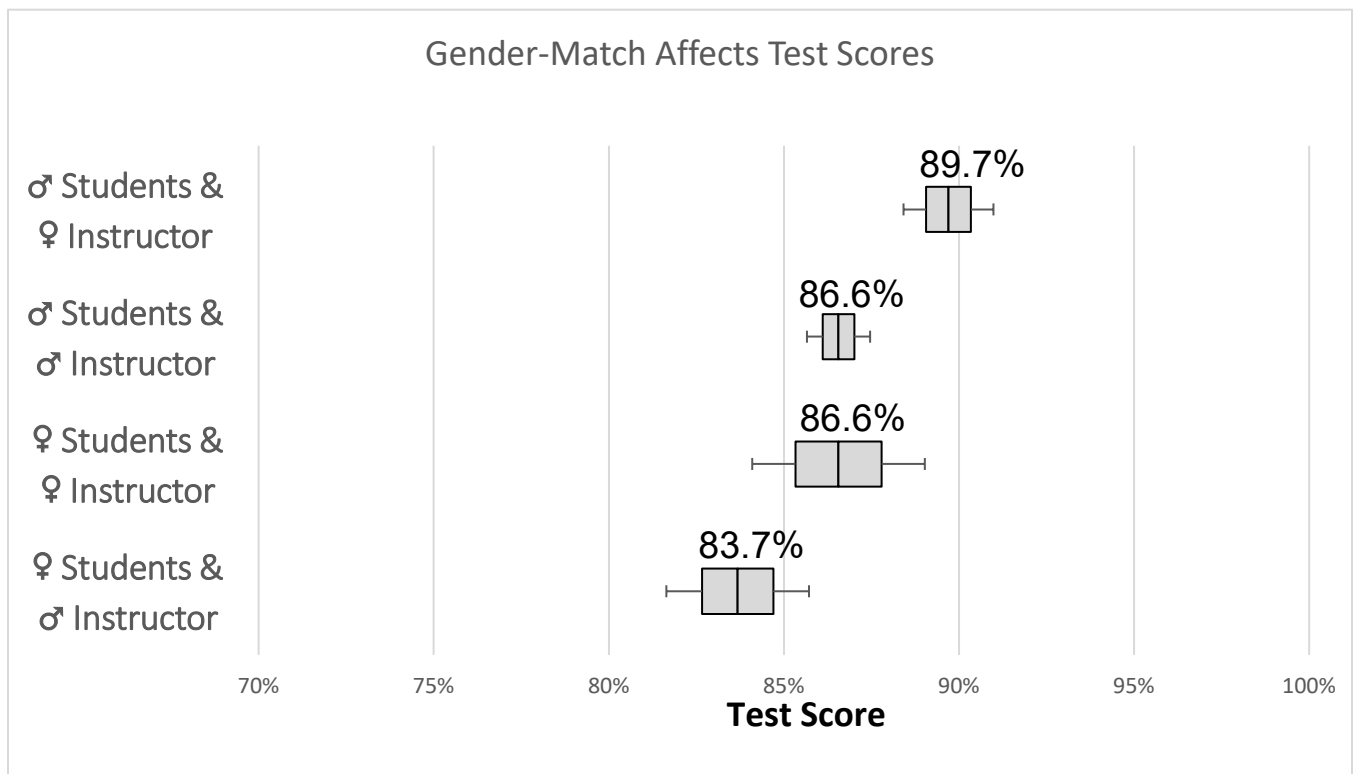
Figure 4. When the genders of the instructors and students match, both male and female students scored similarly (86.6%). However, male students instructed by females do slightly better (89.7%) and female students instructed by males perform slight worse (83.7%).

Discussion

This project represents the first multi-state, nationally representative effort to investigate the impacts of HE delivery methods (virtual-only, in-person-only, and virtual/in-person hybrid) on student preparedness. As in virtually all other education courses, HE uses a final exam score to indicate student comprehension of course curricula. In the case of HE, a student's achievement of a minimum score is used by the state to certify that the student is sufficiently prepared to conduct themselves safely, legally, and responsibly in the field, thus warranting the issuance of a Hunter Education Certification card. This

study does not attempt to assess the validity of using a minimum final exam score to certify student preparedness; rather, it examines how the metric of a final exam score is influenced by HE delivery methods. In addition, this study examines other barriers identified by past research, HE experts, and social science standards likely to be influential in student preparedness directly following their completion of an HE course.

Though this study documented a statistically significant difference in final exam scores between the HE delivery methods examined, that difference is likely not a practically significant one. In other words, for an HE administrator weighing whether one HE delivery method should be adopted or rejected, they should not do so based upon the criteria of final exam score or student satisfaction. There may be other reasons to modify HE delivery policy, but those reasons should move the conversation about HE delivery effectiveness beyond a binary "this or that" framework into a more nuanced decision matrix where all delivery options are considered useful elements of an overall strategy to make HE more serviceable for current and future potential hunters.

It is worth noting that the lack of practical difference in student preparedness within HE delivery methods documented in this study is mirrored in the findings of a National Association of State Boating Law Administrators (NASBLA) study that examined the differences between the retention of learning after completing either in-person or virtual boating safety training (NASBLA, 2012). That study also concluded that course delivery methods had little effect on student learning comprehension, even many months after the course was completed. Therefore, HE administrators should feel confident that current HE course delivery methods are equally capable of delivering course content and achieving the agency standard for safe, legal, and responsible hunter behavior.

In addition to documenting the similar effectiveness of existing HE delivery methods, this study highlights the importance of many other variables that are likely to impact student learning and satisfaction during their completion of an HE course. HE administrators should carefully consider the following aspects of course delivery as they modify and improve their state's HE programs strategy:

- Course delivery preferences by student age, ethnicity, and prior hunting experience
- Gender matching of students and instructor
- Number of course hours and teaching sessions of in-person classes
- Student-to-instructor ratios of in-person classes
- Learning-style preferences of students
- Hands-on firearm safety and live-fire instruction

Based upon reviews of existing hunter education literature and interviews of hunter education experts, it is clear that many of this study's findings were previously undocumented, contentiously debated, or unintentionally discounted. Thus, there exists a critical need for consistent and systematic evaluation of HE curricula and delivery standards, particularly as new course innovations are developed and reviewed. It is the hope of the authors that this study can serve as a catalyst for that work, while also empowering current and future HE administrators to diversify their HE program design in order to increase the accessibility and impact of HE to more of America's future hunters.

Appendix A – Survey Instrument

HUNTER EDUCATION

Thank you for participating in Hunter Education! To begin, we would like to ask you a few questions which will help us improve this course for future participants. Thank you for your time and input.

Please remember that your answers to these survey questions will:

- NOT affect your hunter education test score
- NOT affect whether you pass or fail hunter education
- NEVER be shared with your hunter education instructor, parents, or anyone else outside of our research team

* 1. What best describes your hunter education experience?

(Pick the option that matches your experience as closely as possible)

○ My course was entirely online learning

○ My course was a mix of online learning and in person instruction (like a field day)

○ My course was entirely in person instruction

2. If you know your Hunter ID number, place it here.
If you don't know it or don't have one, please leave this blank.

(Some states call this a Customer ID or Sportsmen's ID number; you can find it on a hunting license or tag)

HUNTER EDUCATION

We'd like to hear your opinions about hunter education experience.

3. First, let's make sure we know what type of hunter education class you were in. What is the 8 digit code that your instructor shared with you?
(It should have 4 letters and 4 numbers)

* 4. How satisfied or dissatisfied are you with your OVERALL hunter education experience?
(Again, we do not share this information with anyone)

- ◯ Very satisfied
- ◯ Satisfied
- ◯ Neither
- ◯ Dissatisfied
- ◯ Very dissatisfied

5. How satisfied or dissatisfied are you with the following aspects of the in-person instruction of hunter education?

(If your course did NOT have an aspect listed, please check "Does Not Apply")

	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied	Does not apply
The main instructor	○	○	○	○	○	○
The assistant instructors	○	○	○	○	○	○
The course's printed materials	○	○	○	○	○	○

6. How satisfied or dissatisfied are you with the following aspects of the online hunter education?

(If your course did NOT have an aspect listed, please check "Does Not Apply")

	Very dissatisfied	Dissatisfied	Neither	Satisfied	Very satisfied	Does not apply
The course website	○	○	○	○	○	○
Videos in the course	○	○	○	○	○	○
The course's printable materials	○	○	○	○	○	○

7. During class, how prepared was your instructor?

○ Extremely prepared

○ Very prepared

○ Somewhat prepared

○ Not so prepared

○ Not at all prepared

HUNTER EDUCATION

8. Consider people who are approximately the same age as you. How easy or hard would this hunter education course be for them?

○ Much too hard

○ Too hard

○ About right

○ Too easy

○ Much too easy

In this next section, we'd like to understand more about you and your hunting-related experiences.

9. How often, if at all, do the following people hunt?

	Never hunted	Less often than every 5 years	Every 2-4 years	About once a year	A few times a year or more
You	○	○	○	○	○
Your immediate family *(parents, siblings)*	○	○	○	○	○
Your extended family *(cousins, aunts/uncles, grandparents, etc.)*	○	○	○	○	○
Your closest friends	○	○	○	○	○

10. Do you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
Hunting is enjoyable to me personally	○	○	○	○	○
It's important to me that I hunt in the future	○	○	○	○	○
I want to go hunting in the near future	○	○	○	○	○
My **family** is supportive of hunting	○	○	○	○	○
Many of my **closest friends** are supportive of hunting	○	○	○	○	○

11. Do you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
If I want to go hunting, it would be easy for me to go	○	○	○	○	○
There's a lot that prevents me from going hunting	○	○	○	○	○
I have someone in my life that could take me hunting	○	○	○	○	○
It's very likely that I will still be hunting many years from now	○	○	○	○	○

12. The following describes different ways people learn. One way of learning is not better than others. Please read all four descriptions and then indicate how well each one describes how you learn.

	I don't really learn this way	I sometimes learn this way	I learn a lot this way, but it is not the main way	This is the main way I learn
I learn best from **visuals,** like pictures, drawings, or diagrams.	○	○	○	○
I learn best from **listening,** like reading out load to myself, rhyming, or using songs.	○	○	○	○
I learn best from **words,** like reading, or writing lots of notes to read later.	○	○	○	○
I learn best by being **active,** like standing/pacing while studying, acting out concepts, or talking with my hands.	○	○	○	○

13. Have you ever participated in a hunter education deferral program or apprentice license program?

○ Yes

○ No

○ I don't know (Check this if you don't know what these programs are)

HUNTER EDUCATION

Almost done! We'd like to know a little about your background.

14. What is the PRIMARY reason you are taking this hunter education course?

- ○ So I can go hunting
- ○ OTHER (such as a firearms course, to learn gun safety, school credit, etc.)

15. What YEAR were you born in? (For example, 2003 or 1999)

16. What MONTH were you born in?

* 17. What is your contact information?
(We will ONLY use this information to verify enrollment. It will never be shared with anyone)

First Name	
Last Name	
City / Town	
State	-- select state --
What are the last four digits of the phone number you use most?	

18. What is your ethnicity?

(Please select all that apply)

- [ ] White
- [ ] Black
- [ ] Hispanic
- [ ] Asian or Pacific Islander
- [ ] American Indian or Alaskan Native
- [ ] Other (please specify)

19. Which of the following best describes you?

- [ ] Female
- [ ] Male
- [ ] Non-binary
- [ ] Prefer to self-describe

- [ ] I prefer not to say

Appendix B – Key Personnel

Alex Baer – Alex is the Executive Director of the International Hunter Education Association and is an active member of the Council to Advance Hunting and the Shooting Sports' Board of Directors. In these roles, Alex has developed a passion to drive successful R3 projects across the industry. He has also helped craft business plans for partners in the conservation industry during his time as an industry consultant. These experiences, along with his time as the Director of Sales and Business Development at onXmaps, Inc., have led Alex to develop an appreciation for and progress through partnership and relevant research.

Dr. Loren Chase - Loren is a social scientist and research methodologist with degrees in wildlife biology and human dimensions of wildlife. He has nearly a decade of experience within state wildlife agencies, working as a Human Dimensions Research Coordinator and as a Manager of Budget & Economic Analysis. He was instrumental in groundbreaking human dimensions research that led to increases in conservation revenues and participation in hunting and fishing. He served as Chair and Vice Chair of the WAFWA HD Committee, Chair of The Wildlife Society HD Working Group, and Director-at-Large of the Arizona Wildlife Federation. He is a peer-review editor for six academic journals and regularly publishes articles in peer-reviewed journals, as well as lay articles regarding people and wildlife. Loren is currently the primary at Chase & Chase Consulting, a research firm with expertise in data mining, program evaluation, and business intelligence, with an emphasis in wildlife conservation. Notable research work includes the appearance of The Future of Hunting and Fishing project on NPR, a social justification of hunting on NBC, and the recruitment of hipster hunters in *The Wall Street Journal*.

Matt Dunfee - Matt is the Director of Special Programs for the Wildlife Management Institute. In his past and current positions with WMI, he has served as the Conservation Program Specialist in WMI's Washington D.C. Headquarters, where he worked on numerous projects related to North American wildlife conservation, private lands programs, and hunting heritage. He also serves as the Director of the Chronic Wasting Disease Alliance, the Chair of the North American Wildlife and Natural Resources Conference, and Co-Chair of the National Hunting and Shooting Sports Action Plan. In his current roles, Matt serves on numerous professional committees and boards, including the AFWA Fish and Wildlife Health Committee, national and regional AFWA Hunting and Shooting Sports Participation Committees, the Conservation Leaders for Tomorrow Advisory Committee, the North American Wildlife and Natural Resources Meeting Steering Committee, and the International Hunter Education Association Standards Committee. Following his leadership in developing evaluation toolkits for hunter and shooter R3 efforts, Matt has conducted numerous multi-day training and information workshops for state and federal wildlife agency staff and administrators on R3 strategies, program development, evaluation, and best practices.