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Distance Education in Nutrition and Dietetics Education over the last 30 Years: A Narrative Review

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TITLE/AUTHORS:

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J. Bueche and K. Stote conceived idea and identified research objectives. J. Bueche took lead on writing the manuscript. J. Jensen directed the search and wrote the methods section of this manuscript. Subject Matter Experts: J. Bueche, K. Martin, E. Riddle, and K. Stote collectively cross-checked articles for ex/inclusion and summarized content from articles. All authors reviewed subsequent drafts of the manuscript.

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Distance Education in Nutrition and Dietetics Education over the last 30 Years: A Narrative Review

1 Research Snapshot

2 **Research Question:** How has distance education in nutrition and dietetics education evolved
3 over the past 30 years? Has distance education had an impact on the knowledge, skills, and
4 attitudes of nutrition and dietetics students and educators?

5 **Key Findings:** In the past 30 years, the attitudes and perceptions of distance education have
6 evolved as barriers to online access have diminished, and the availability of online courses and
7 accredited distance programs has expanded. However, there remains a paucity of research about
8 the use of distance education in nutrition and dietetics, and its impacts on knowledge, skills, and
9 attitudes of both nutrition and dietetics students and educators.

10

11 ABSTRACT

12 The COVID-19 pandemic necessitated the use of distance education, which sparked a
13 technological transformation that was long overdue in higher education. The purpose of this
14 narrative review is two-fold: 1) to summarize the state of knowledge regarding distance
15 education in nutrition and dietetics education over the last 30 years to inform recommendations
16 for future education/research and implications for practice and 2) to determine the impact that
17 distance education has had on the knowledge, skills, and attitudes of both nutrition and dietetic
18 educators and their students. A narrative review of 822 publications yielded 25 that met the
19 search criteria. In the scope of thirty years, the literature shows that attitudes and perceptions of
20 distance education have changed as barriers to online access have diminished and the availability

21 of online nutrition and dietetics courses and ACEND accredited distance education programs has
22 expanded. However, while the limited results are promising, the paucity of large-sample research
23 about the use of distance education in nutrition and dietetics education restricts educators'
24 knowledge of and ability to evaluate the learning outcomes of distance programs and courses.
25 Moreover, differences in how accreditors, government agencies, and institutions define "distance
26 education" could have significant impact on funding, financial aid benefits for students and
27 research. Recommendations for future research and implications for practice are provided given
28 the relevance and importance of distance education to nutrition and dietetics education.

29 **INTRODUCTION**

30 In the spring of 2020, the COVID-19 pandemic transformed higher education by putting distance
31 education front and center. This technological transformation challenged the traditional lecture-
32 based brick and mortar model that has been in place in higher education for hundreds of years¹.
33 In the fall of 2019, a total of 36.3% of undergraduate and 42.3% of graduate students were taking
34 distance education courses² in the United States. A year later (fall 2020), 73% of students in
35 post-secondary institutions were enrolled in distance education courses³. As COVID-19
36 recommendations changed, so did course delivery and expectations for both educators and
37 students.

38 Like all educators, nutrition and dietetic instructors were required to transition to online course
39 delivery within a very short time, with most having minimal training and experience in online
40 course development and teaching⁴. The unexpected transition to online course delivery
41 negatively impacted many students including dietetic students who were already stressed by the
42 effects of the COVID-19 pandemic. A cross-sectional online survey was conducted between
43 February and March 2021 to examine dietetics students' perceptions of the COVID-19

44 pandemic's impact on academics and mental and physical health⁵. The dietetic students who
45 participated (n=526) were enrolled in either a didactic program in dietetics (DPD) or coordinated
46 program in dietetics (CPD) for both fall 2000 and spring 2021. The survey was distributed to all
47 DPD and CPD directors listed on the ACEND website in February 2021. Survey results reported
48 that students took 78% of their courses online during the fall 2020 semester. During this
49 semester, 87% of dietetic students experienced increased stress, 64% reported mental health
50 concerns, and 32% reported disordered eating due to the COVID-19 pandemic. In terms of
51 academics, the majority of students agreed that COVID-19 negatively impacted the quality of
52 their education and reported that they learned less in the fall of 2020 than normal. However, the
53 majority of students also agreed that their program met their educational needs and that DPD
54 courses could be taught effectively online/remotely. While positive impacts to students receiving
55 online education during the pandemic may have included reduced commuting costs, reduced
56 stress related to potential COVID-19 exposure, and higher GPAs,⁵ initial findings among health
57 profession students highlight the negative mental and physical health impacts of this rapid and
58 unexpected transition to online education⁶⁻⁹.

59 It is important to differentiate this rapid and unexpected transition to online education from
60 intentional, well-planned, and well-supported online education. The concept of distance
61 education has been around since the 19th century, and the definition has evolved alongside
62 advances in technology¹⁰⁻¹⁴. Distance education in the dietetics profession began in the 1970's
63 with the delivery of continuing education lectures using a telephone network¹⁵. The definition of
64 distance education has changed over time due in large part to the advancement of technology,
65 especially in the early 1990's with the availability and increased access to personal computers
66 and public access to the world wide web beginning in 1993. Most distance education today is

67 done online and the term “online learning” is often used when what is meant is “online
68 education”, which better encompasses both teaching and learning aspects¹⁶. This paper uses the
69 term “distance education” because the review covers pre-online programs. Reflecting the
70 differences in terminology and technology, the Department of Education amended the Higher
71 Education Act of 1965 (effective July 1, 2021) to establish that distance education is
72 distinguishable from correspondence courses since correspondence courses do not provide
73 regular and substantive interaction¹⁷.

74 For the purposes of this review, distance education is defined by Open SUNY/Integrated
75 Postsecondary Education Data System (IPEDS) as:

76 *Education that uses one or more technologies to deliver instruction to students who are*
77 *separated from the instructor and to support regular and substantive interaction between*
78 *the students and the instructor synchronously or asynchronously. Technologies used for*
79 *instruction may include the following: Internet, one-way and two-way transmissions*
80 *through open broadcasts, closed circuit, cable, microwave, broadband lines, fiber optics,*
81 *satellite or wireless communication devices; audio conferencing; and video cassette,*
82 *DVDs and CD-ROMs, if the cassette, DVDs, and CD-ROMs are used in courses in*
83 *conjunction with the technologies listed above¹⁴.*

84 In 2022, there were 29 accredited distance education nutrition and dietetics education programs:
85 three A.A.S. programs, four B.S. degrees with one program offering both a B.S. and M.S., and
86 22 graduate programs, of which half are Future Education Model Graduate Degree Programs
87 (GP). Referring to ACEND’s Policy and Procedure manual (p. 66), ACEND defines distance
88 education as: “the delivery of 50% or more of didactic courses in the professional curriculum
89 where students are separated from instructors and learning synchronously or asynchronously

90 through live or recorded media.”. It is anticipated that growth in distance learning in higher
91 education will continue to outpace total enrollment growth given students’ demands and
92 preferences, program affordability, and increased accessibility to higher education¹⁸. In the fall
93 2021, the National Council for State Authorization Reciprocity Agreements (NC-SARA)
94 released findings from a voluntary study of SARA-participating institutions (n=2,200) and found
95 that 59% of these institutions plan to continue some or all of their emergency remote learning
96 offerings via distance education after the pandemic¹⁹. As a result, there will be more demand on
97 faculty to develop distance courses and/or programs which will have a significant impact on
98 nutrition and dietetics education.

99 **OBJECTIVES**

100 The purpose of this narrative review is two-fold: 1) to summarize state of knowledge regarding
101 distance education in nutrition and dietetics education over the last 30 years to inform
102 recommendations for future education/research and implications for practice and 2) to determine
103 the impact that distance education has had on the knowledge, skills, and attitudes of both
104 nutrition and dietetics educators and their students.

105 **METHODS**

106 To gather a complete picture of the literature in the field, the authors conducted a search across
107 five major electronic databases used in the health/dietetics and education fields, which included a
108 mix of U.S. government-provided and library-subscribed databases. Electronic database searches
109 were conducted in January and February 2022 in the following five databases: PubMed,
110 CINAHL (Cumulative Index to Nursing and Allied Health Literature) Plus with Full Text

111 (EBSCO), CAB Direct (Nutrition and Food Science and CABI Direct subscriptions), MedLine
112 with Full Text (EBSCO), and ERIC (EBSCO).

113 Search terms were refined as the research objectives were finalized. For each database, the
114 relevant controlled vocabulary was documented and included in a mix of subject and keyword
115 searches, including MeSH terms where available. Combinations of the search terms used in the
116 database searches are listed in Table 1.

117 Where possible, search results were filtered to exclude publications from outside the United
118 States (US) and published before 1990. Not every database had reliable geographic filters, so
119 many non-US papers were included in the final list and later excluded during the paper selection
120 process. The rationale for excluding articles prior to 1990 was based on the fact that the internet
121 was not made public until 1993 and functionality and access to personal computers was limited.
122 Once duplicate and pre-1990 publications were removed, a total of 822 papers were identified by
123 the search process.

124 The next step was to screen the list of publications for inclusion in or exclusion from the
125 narrative review. To address the research objectives, the research team determined a set of
126 criteria by which to evaluate each publication for inclusion or exclusion in the data analysis.

127 Generally, the inclusion criteria sought English-language studies or reports about nutrition and
128 dietetics programs for undergraduate/graduate/professional students that applied distance
129 education methods in the U.S.

130 Research publications, reviews, and reports were included. The database search results returned
131 several conference abstracts describing research projects without full publications. Due to the

132 lack of information about their research process, the abstracts were excluded from the data
133 analysis of the narrative review process.

134 Publications about professional and/or higher education courses and programs for dietetics
135 students in the US were included. Publications about classes mixed with general education
136 students were allowed only if the course was required for undergraduate or graduate nutrition
137 and/or dietetics majors. Publications about nutrition interventions or continuing education for
138 dietetics professionals were excluded.

139 After discussion about the evolving nature and definitions of distance education, the team
140 determined that to be included as a distance education-focused publication, the course or
141 program studied in the research publication must fit the Open SUNY/IPEDS distance education
142 definition (see above). This excluded publications about mail-based (not e-mail based) distance
143 learning courses.

144 With these criteria as a guide, the title and abstract of the 822 publications were independently
145 screened by at least two of the research team's subject matter experts to include, exclude, or
146 "maybe include" each paper. Where the two initial reviewers disagreed on inclusion/exclusion or
147 a publication was marked as "maybe" by one or more of its initial reviewers, the publications in
148 question were marked for full-text review.

149 Most publications (790 publications) were removed in the initial review because they fell outside
150 scope of the narrative review. The inclusion/exclusion review process found that many of the
151 publications included non-US subjects or described nutrition interventions (not higher education-
152 level courses or programs), which were excluded.

153 A total of 33 publications underwent a full text review by all four subject matter experts on the
154 research team, yielding 25 publications identified for inclusion in the narrative review. The
155 reasons for excluding eight of the remaining publications was because either the target
156 population did not meet the inclusion criteria, or no distance education was used. The results of
157 each stage of the inclusion review process are depicted in Figure 1.

158 **DISCUSSION**

159 *General Characteristics*

160 The 25 publications included in this narrative review are summarized in Table 2. Publications
161 were grouped based on major themes and in chronological order: 1) Distance Education Then
162 and Now, 2) Effects of Computer-Assisted Instruction on Learning, and 3) Outcomes
163 Assessment Using Distance Education. The review spanned 30 years with articles from each
164 decade represented as follows: 5 publications from the 1990's, 12 publications from the 2000's,
165 4 publications from 2010's and 4 publications from current decade. These publications included
166 4 definitions of distance education with 19 synonymous terms. The number of synonyms was
167 similar to findings reported by Singh and Thurman in a systematic review of the definitions of
168 online learning (1988-2018, ERIC database) which yielded 46 definitions with 18 synonymous
169 terms from 37 resources¹⁶.

170 *Distance Education Then and Now*

171 The research shows that attitudes and perceptions of distance education changed as barriers to
172 online access diminished and the availability of online courses and accredited distance programs
173 expanded. From 1995 to 2005, there was a 10-fold increase in the use of distance education
174 based on a survey of directors of CAADE-accredited undergraduate programs^{20,21}.

175 Approximately 32% (n = 150) of undergraduate dietetics programs were offering distance
176 education courses in some format in 2005, although none of the surveyed institutions offered a
177 complete undergraduate DPD program online. Then, in 2021, the COVID 19 pandemic forced
178 the use of distance education in the form of emergency remote teaching (ERT)²², defined as a
179 temporary shift of instructional delivery to an alternate delivery mode for all dietetic education
180 programs in the U.S., including an undergraduate and graduate dietetics program at New Mexico
181 State University (NMSU)²³.

182 Access to computers and comfort in their use has increased significantly over the last 30 years as
183 well. In the late 1990's, one of the first studies to examine these factors utilized a self-
184 administered questionnaire to assess differences in computer experiences between students
185 enrolled in a dietetics distance education program and their preceptors²⁴. The study found that
186 computer access for students at home (24%) was lower than the national average (35%) with
187 only 46% of students and 49% of preceptors in the study having access to a modem and the
188 internet. Still, overall attitudes towards computers were relatively positive, especially among
189 preceptors.

190 In the late 1990's and early 2000, delivery of distance nutrition courses using an email
191 component or an electronic listserv were found to increase the communication between students,
192 faculty and/or preceptors^{25,26}. In the early 2000's, two studies of distance dietetic internship
193 programs^{27,28} observed improvements in attitudes towards online delivery, including findings
194 that dietetic interns that preferred to work collaboratively took advantage of online instruction
195 opportunities more often, time spent using online instruction positively impacted attitudes
196 towards computer use, and internet use improved regardless of whether online instruction was
197 available.

198 Distance education continued to evolve with technological advances. The 2005 survey of
199 CAADE accredited programs found that the most common distance education dietetics course
200 offered was a basic or introductory nutrition course (31%) and 48% of distance education
201 courses were offered as 100% internet (online) courses²¹. The use of Blackboard—a learning
202 management software designed to deliver an online course—was described by Fariior and
203 Gallagher in 2000²⁹ and found that while enrollment increased by 15% in the two online courses
204 described, student course evaluations rated interaction between student and instructor as low.
205 Benefits of online course delivery reported included convenience, timeliness, and ease of access.
206 In 2007-2008, 9.5% of graduate students were enrolled in an online graduate program
207 nationally². With the impact of the COVID-19 pandemic, 7 million post-baccalaureate students
208 were exclusively enrolled in distance education courses in 2020 compared to 2.4 million in 2019;
209 a 186% increase from the previous year³⁰. A 2007 invited review described good online
210 programs as those that offer an advanced degree and are experienced in online education,
211 positively regarded, and housed within an accredited institution. This review also described the
212 characteristic of successful online students as those who are self-directed, flexible, committed
213 and self-disciplined³¹. Distance education has evolved to focus on a student-centered approach
214 that creates regular and substantial interaction (RSI) among peers and instructors. In 2019, the
215 online versus in-person delivery of courses was assessed by collecting perceptions and opinions
216 of graduate clinical nutrition students (N=176, 32.8% response rate) at a midwestern university.
217 Results indicated that perceptions varied and were dependent on individual learning style³².
218 Students perceived a synchronous delivery mode to have significant benefits for learning,
219 networking, and professional development due to the structure, connection, and real-time
220 interaction supported by this model. An evaluation of student outcomes using multiple

221 assessment methods (capstone experience, oral comprehensive examination, and e-portfolio)
222 showed enhanced learning, synthesis of information, and readiness to contribute as a member of
223 the healthcare team.

224 *Effects of Computer-Assisted Instruction on Learning*

225 Computer-Assisted Instruction (CAI) is an interactive instructional technique that uses
226 technology in the form of computers and software application to teach concepts or skills to
227 enhance the learning process. CAI can be embedded into an in-person course or used as a
228 supplemental tool to enhance the learning process. The use of CAI to enhance or supplement in-
229 person education was evaluated by eight publications included in this narrative review³³⁻⁴⁰.
230 Collectively, these studies consistently showed equivalent or better outcomes for students
231 participating in CAI when compared to students not participating in CAI³³⁻⁴⁰. The use of CAI as
232 a supplement to lecture consistently led to equivalent or better grades/ performance on
233 knowledge exams^{33,34,36}. The use of CAI was shown to enhance clinical reasoning skills, improve
234 students' abilities to choose counseling approaches³⁷, and increase knowledge on Nutrition
235 Focused Physical Exams^{36,38}. CAI was also used to enhance student education on diabetes
236 mellitus and the nutrition care process⁴⁰.

237 Overall, students' attitudes towards the use of computers were positive across studies. Students
238 reported that CAI programs were useful, reinforced and reviewed lecture materials, and helped
239 them improve their grades³⁴. Students' responses to CAI or ILA's were measured in 5 of the 8
240 publications and all reported that students responded positively to the use of CAI. However, care
241 must be taken when designing CAI programs. When CAI was first introduced, some students
242 reported not knowing how to use the CAI programs³⁴. While unfamiliarity with technology may

243 be less prevalent than it was 20 years ago, CAI use still requires a level of technological
244 awareness.

245 *Outcomes Assessment Using Distance Education*

246 Over a 20-year period (2002 – 2021), six publications reported on outcomes of distance
247 education programs for students (student learning outcomes) or for graduates (program
248 outcomes). Two of the six publications were interrelated with one describing the 4 key steps
249 required for development and approval of a pilot master's in public health nutrition program
250 using distance education (which took 5 years to complete) and the follow up study assessing the
251 outcomes of the pilot program^{41,42}.

252 *Program Development and Program Outcomes*

253 The assessment of the outcomes of a distance-based pilot master's in public health nutrition
254 demonstrated that it is possible to deliver a CAADE accredited Graduate Coordinated Dietetics
255 Program with the ability to earn a master's in public health (MPH) using distance strategies⁴². It
256 was reported that 9 out of 10 graduates of the program were promoted within a year after
257 graduating with their MPH. Low enrollment and a greater attrition rate were found to be issues
258 when compared to the residential program. A second publication compared program outcomes
259 for distance dietetic internships (n=5) versus traditional, in-person dietetic internship (n=7)⁴³.
260 The results of this study did not support equivalency in preparedness of graduates. Preparedness
261 based on ability to communicate, provide nutrition therapy, clinical judgment, independence, and
262 work ethic were rated higher on graduate surveys by in person graduates and their supervisors
263 with no difference noted between in person graduates and distance graduates on ability to
264 counsel patients and ability to manage foodservice systems. The in-person dietetic internship

265 programs were matched to participating distance dietetic internship programs based on size,
266 geography, institution type and emphasis area.

267 *Student Learning Outcomes*

268 Three publications evaluated student learning outcomes for students enrolled in online dietetics
269 programs with two of the 3 collaborating with other dietetic programs. All three showed a
270 positive impact of distance learning that included: 1) improvement on key-feature pre and post
271 exam scores in nutrition support and pediatric nutrition for students enrolled in 3 different online
272 dietetic internship programs with post-test scores of nutrition support calculations more
273 predictive of performance on the registration exam for dietitians⁴⁴, 2) significant improvement
274 from baseline in 8 of 11 research skills in an online non-thesis master's program based on
275 students self-report of skills and interest in research before and after completing a 4-course
276 research curriculum⁴⁵, and 3) demonstrated skills development in systems thinking assessed by
277 subject matter experts and more confidence in ability to perform learning outcomes as reported
278 by learners who completed an optional online three-part webinar series from dietetic internship
279 programs and coordinated graduate programs at four university sites⁴⁶.

280 The impact of distance education on program outcomes and student learning outcomes in
281 dietetics largely parallels results seen in other health science fields. Several systematic reviews
282 have reported that students enrolled in health science distance education programs perform
283 modestly better or no differently than those enrolled in traditional face-to-face instruction with
284 no difference in professional skills or behaviors once students enter the workplace⁴⁷⁻⁴⁹.

285 Particular to dietetics education, ACEND holds both distance and in-person programs
286 responsible for the preparedness of graduates. Through accreditation, both types of programs are
287 held to the same standards and are required to ensure that experiences are comparable and lead to

288 the equivalent preparedness of graduates for entry-level practice. Thus, if conducted properly,
289 distance education can lead to equivalent or superior student outcomes while providing students
290 with additional flexibility and opportunity, especially for nontraditional students^{48,49}. However,
291 the barriers to distance education should not be overlooked. Technical problems, poor
292 pedagogical design, low self-efficacy, and limited access to required technology, especially for
293 students from less privileged socioeconomic backgrounds, can all impede the effectiveness of
294 distance education programs^{47,49}. To succeed in effective distance education, universities should
295 invest in proper IT infrastructure and technical support to ensure that all students have access to
296 the technological resources needed. Universities should also train distance education instructors
297 in best practices in online education to ensure that instructors develop the pedagogical
298 knowledge, communication skills, and digital literacy necessary to support students in a
299 collaborative, online environment. To this end, the 2022 ACEND Standards include the
300 evaluation of distance education programs which address the need for faculty training and
301 support on distance learning technology and distance education pedagogy to ensure effective
302 teaching. To develop an effective distance education program, instructors must be trained to
303 support students in the online environment, which often requires students to have greater
304 independence, motivation, and time-management⁴⁵.

305 ***Distance Education in Medical and Health Professions Education***

306 A review of distance education in medical and health professions education provides guidance to
307 nutrition and dietetic educators in assessing the impact of distance learning on professional
308 preparation as well as facilitate research studies in dietetics practice and education. For example,
309 in 2015, the National Council of State Boards of Nursing (NCSBN) published a white paper:
310 *Nursing Regulation Recommendations for Distance Education* that reflected the NCSBN's

311 Distance Learning Education Committee recommendations for distance education prelicensure
312 programs that is relevant to nutrition and dietetics⁵¹. Recent research shows best practices for
313 effective implementation of online teaching and learning in medical and health professions
314 education^{50,52}. Two studies showed nursing student's perception of online learning and its
315 impact on knowledge while others showed factors affecting student engagement in online
316 learning among health science and medical students⁵³⁻⁵⁶. In addition, Car et al, identified
317 research gaps and priorities in distance health professions education⁵⁷. Data from these studies
318 may be adapted to facilitate research in dietetics practice and education.

319 **SUMMARY AND FUTURE RESEARCH**

320 Many of the issues related to delivery of distance education, access to and comfort with
321 computers have been improved and/or resolved with the "Information Age" and advancement of
322 technology. Distance education has moved online and thus much of the conversation about
323 distance education is now centered around online education especially online learning. There are
324 differences in how accreditors, federal, state and/or local agencies and institutions define
325 distance education and related terms such as hybrid/blended courses. These differences could
326 have significant impact on funding, financial aid benefits for students and research. This includes
327 student visa status which impacts access as international students on F1 visas are only able to
328 take one online course per semester while in the United States⁵⁸. Thus, a standardized definition
329 of distance education and related terms is needed. For future research, it is recommended that the
330 definition for distance education reflect two major components: delivery of education using one
331 or more technologies when teacher and student are separated and regular and substantive
332 interaction between the student and the instructor must occur.

333 In 1995, data showed that distance education in dietetics education was provided on a limited
334 basis²⁰. ACEND's Accredited Programs Directory classifies programs that provide coursework
335 and/or rotations entirely online as "distance education" programs. While the number of ACEND-
336 accredited distance education programs has increased, there is no information about programs
337 that utilize some form of distance education but do not meet ACEND's definition of a distance
338 education program.

339 Given the technological transformation that has occurred in higher education due to the COVID-
340 19 pandemic, the value of intentional, well-planned, and well-supported distance education has
341 been realized. In 2020, Research and Markets reported that the growth of distance education is
342 predicted to increase at a compound annual growth rate (CAGR) of 9.23%, reaching \$319.167
343 billion by 2025⁵⁹. Currently, there are 293 distance education programs for regionally and
344 nationally accredited nutrition master's degrees nationwide, some of which are also accredited
345 by the Accreditation Council for Nutrition Professional Education (ACNPE) or ACEND,
346 compared to less than 50 in 2014⁶⁰. The demand for distance education has had a significant
347 impact on expected competencies of nutrition and dietetic educators reflecting advances in
348 education since 2009 and are included in the revised 2018 Standards of Professional
349 Performance for Registered Dietitian Nutritionists (RDNs) (Competent, Proficient, and Expert)
350 in Education of Nutrition and Dietetics Practitioners (EONDP)⁶¹. Thus, it is critically important
351 that nutrition and dietetic educators be knowledgeable and skilled in applying best practices in
352 the delivery of quality nutrition and dietetics education and utilize technological advancements
353 undergirded by education theory to meet the increasing demand for distance education in higher
354 education.

355 After COVID-19 forced faculty and college students to move teaching and learning online, the
356 disparities between students with and without reliable access to internet and/or computers
357 became more visible uncovering a major issue of equity and access for students. While it is
358 reported that 97% of the American population owns a computer, access to reliable broadband
359 service is problematic for low income and rural Americans. The Biden administration has
360 earmarked \$100 billion dollars to bring affordable internet to “all Americans” by 2029⁶².
361 Despite the very limited number of publications using CAI and/or computer-based simulation
362 (CBS) in nutrition and dietetics education in this review, all demonstrated at least equivalent if
363 not improved student learning outcomes and when measured were well received by students.
364 There is limited research on perceptions and attitudes of nutrition and dietetic educators use of
365 CAI and/or simulation. The challenges of using CAI need to be considered and include: 1)
366 technology comes with a cost, 2) the investment in time is significant, and 3) the content and/or
367 the technology itself can become outdated. CAI should be used to enhance learning but not as a
368 replacement for the instructor. Potential applications and benefits of CAI and/or simulation can
369 provide nutrition and dietetic students with increasing levels of complex real-life experiences to
370 assess and improve: 1) clinical reasoning skills, 2) the ability to problem solve, and 3) the
371 development of higher order thinking skills such as system thinking. This could have a
372 significant impact on the preparation of students for supervised practice/experiential learning
373 allowing students to feel more confident and progress at a higher rate and level in terms of
374 knowledge and skill. Additionally, exposure to complex conditions and/or advanced practice
375 level registered dietitians would be possible for students in remote areas or who are working in
376 smaller community hospitals.

377 While there were only two interrelated studies that reported on the feasibility and success of
378 delivering an accredited coordinated graduate (MPH) program, continued accreditation status of
379 ACEND-accredited distance education programs in nutrition and dietetics provides evidence that
380 quality distance education programs within nutrition and dietetics education exist despite limited
381 research and reporting. The number of ACEND-accredited distance education nutrition and
382 dietetics programs has increased yet they represent only 4.6% of the number of ACEND-
383 accredited nutrition and dietetic programs.

384 There was limited research regarding the impact of distance education on student learning
385 outcomes in nutrition and dietetics education. Again, this was not true outside of nutrition and
386 dietetics education. While statistically significant and considered modest (an average effect size
387 of +0.20 favoring online conditions), the most cited and well-respected meta-analysis funded by
388 the U.S. Department of Education found that student achievements of learning outcomes were
389 better for online learning as compared to the traditional format⁶³. Results do not suggest that
390 online learning is superior, but the measurable differences found were attributable to time spent,
391 curriculum and pedagogy used in the online format.

392 The paucity of research about the use of distance education in nutrition and dietetics education
393 persists today. There were only 7 publications related to distance education in nutrition and
394 dietetics education in the last decade. Moreover, there was a lack of research on the impact that
395 distance education has had to date on the knowledge, skills and attitudes of nutrition and dietetic
396 students and even less so on nutrition and dietetic educators.

397 Recommendations for future research include:

- 398 • supporting research on distance education and emerging technologies to ensure the
399 provision of high-quality nutrition and dietetics education in the preparation of competent
400 nutrition and dietetic professionals and continuing professional education;
- 401 • identifying models for distance learning research used in other medical professions that
402 could provide guidance to dietetics professionals going forward to assess the impact of
403 distance learning on professional preparation and facilitate research studies in nutrition
404 and dietetics education and practice.
- 405 • surveying on the attitudes of nutrition and dietetic students, educators, and preceptors
406 regarding distance education and the use of distance education in dietetics should be
407 conducted on a regular basis (every 5 years) to better assess the progress of distance
408 education and need for education, training, and resources;
- 409 • determining of predictors of success when designing, implementing, and evaluating
410 distance education at the program and course level with the purpose of establishing
411 quality standards and best practices for distance education in the nutrition and dietetics
412 profession; and
- 413 • examining the use of current and emerging technologies (CAI, CBS) as part of effective
414 online instructional strategies to better prepare students for supervised
415 practice/experiential learning and maximize learning given the shortage of preceptors and
416 clinical sites.

417 The significant increase in the use of distance education in dietetics education programs as well
418 as the advancement of technology over the last 30 years was reflected by the publications
419 included in this review. In the scope of thirty years, the research showed that attitudes and
420 perceptions of distance education changed as barriers to online access diminished and the

421 availability of online courses and accredited distance programs has expanded. The importance of
422 having well-trained and skilled nutrition and dietetic educators who have the ability to
423 effectively utilize distance-based technology in the delivery of high-quality online nutrition and
424 dietetics education has been identified in the 2022 ACEND Standards. However, the benefits of
425 the use of high-quality distance-based education are not well documented in nutrition and
426 dietetics education, thus more research is required.

427 *Implications for Practice*

428 The mission of ACEND is to ensure the quality of nutrition and dietetics education to advance
429 the practice of the profession. Fostering innovation in nutrition and dietetics education is one of
430 ACEND's strategic goals. To ensure the quality of distance education in nutrition and dietetics
431 education:

- 432 • *Nutrition and dietetics educators will need to be skilled in utilizing educational theory*
433 *and best practices in distance education to provide high quality learning experiences for*
434 *students and ensure competencies are met based on ACEND standards while meeting the*
435 *increasing demand for distance education in higher education.*
- 436 • *Nutrition and dietetic educators will need to be supported in the scholarship of teaching*
437 *and learning (SoTL) with emphasis placed on distance education given the expected*
438 *growth in online course and program delivery.*
- 439 • *The reasons for the lack of research in distance education in nutrition and dietetics*
440 *education needs to be identified and the degree of their impact so that strategies can be*
441 *developed including collaborative opportunities to support educational research and the*
442 *SoTL.*

- 443 • *Utilize expertise of ACEND-accredited Program Directors and nutrition and dietetics*
444 *faculty experienced in distance education to establish quality standards for distance*
445 *education in nutrition and dietetics education.*

446

447

448

449

450 **References**

451

- 452 1. Gallagher S, Palmer J. The pandemic pushed universities online: The change was long overdue. *Harv*
453 *Bus Rev.* Published online September 29, 2020. [https://hbr.org/2020/09/the-pandemic-pushed-](https://hbr.org/2020/09/the-pandemic-pushed-universities-online-the-change-was-long-overdue)
454 [universities-online-the-change-was-long-overdue](https://hbr.org/2020/09/the-pandemic-pushed-universities-online-the-change-was-long-overdue)
- 455 2. [data set] National Center for Education Statistics. *Number and percentage of graduate students*
456 *enrolled in distance education or online classes and degree programs, by selected characteristics:*
457 *selected years, 2003-04 through 2015-16 (Table 311.32).* Digest of Education Statistics; 2020.
458 Accessed March 30, 2022. https://nces.ed.gov/programs/digest/d19/tables/dt19_311.32.asp
- 459 3. [data set] National Center for Education Statistics (NCES). *Back to school statistics: college: distance*
460 *learning.*; 2020. Accessed April 14, 2022. [https://nces.ed.gov/fastfacts/display.asp?id=372#College-](https://nces.ed.gov/fastfacts/display.asp?id=372#College-distancelearning)
461 [distancelearning](https://nces.ed.gov/fastfacts/display.asp?id=372#College-distancelearning)
- 462 4. Kerr-Sims S, Baker DM. Faculty perceptions of teaching online during the covid-19 university
463 transition of courses to an online format. *J Teach Learn Technol.* 2021;10(1).
464 doi:10.14434/jotlt.v10i1.31621
- 465 5. Coakley KE, Gonzales-Pacheco D. Dietetics students' perceptions of academic and health impacts of
466 the covid-19 Pandemic. *Top Clin Nutr.* 2022;37(3):227-235. doi:10.1097/TIN.0000000000000291
- 467 6. Kells M, Jennings Mathis K. Influence of covid-19 on the next generation of nurses in the united
468 states. *J Clin Nurs.* 2022;00:1-9. doi:10.1111/jocn.16202
- 469 7. Ng L, Seow KC, MacDonald L, et al. Elearning in physical therapy: lessons learned from transitioning
470 a professional education program to full elearning during the covid-19 pandemic. *Phys Ther.*
471 2021;101(4):pzab082. doi:10.1093/ptj/pzab082

- 472 8. Akinkugbe AA, Garcia TD, Smith CS, Brickhouse TH, Masovel M. A descriptive pilot study of the
473 immediate impacts of COVID-19 on dental and dental hygiene students' readiness and wellness. *J*
474 *Dent Educ.* 2021;85:401-410. doi:10.1002/jdd.12456
- 475 9. Rose S. Medical student education in the time of covid-19. *JAMA.* 2020;323(21):2131.
476 doi:10.1001/jama.2020.5227
- 477 10. Barker BO, Frisbie AG, Patrick KR. Concepts: Broadening the definition of distance education in light
478 of the new telecommunications technologies. *Am J Distance Educ.* 1989;3(1):20-29.
479 doi:10.1080/08923648909526647
- 480 11. Keegan DJ. On defining distance education. *Distance Educ.* 1980;1(1):13-36.
481 doi:10.1080/0158791800010102
- 482 12. Faibisoff SG, Willis DJ. Distance education: definition and overview. *J Educ Libr Inf Sci.*
483 1987;27(4):223. doi:10.2307/40323650
- 484 13. Willis BD. *Effective distance education: a primer for faculty and administrators.* 1st ed. University of
485 Alaska System, Statewide Distance Education; 1992.
- 486 14. OPEN SUNY. Online learning data definitions. Published online May 2020. Accessed March 12, 2022.
487 [https://online.suny.edu/wp-content/uploads/2020/05/SUNY-and-IPEDS-Online-Learning-](https://online.suny.edu/wp-content/uploads/2020/05/SUNY-and-IPEDS-Online-Learning-Definitions-May-2020.pdf)
488 [Definitions-May-2020.pdf](https://online.suny.edu/wp-content/uploads/2020/05/SUNY-and-IPEDS-Online-Learning-Definitions-May-2020.pdf)
- 489 15. Spears MC, Moore AN. Telelectures vs. workshops in continuing professional education. *J Am Diet*
490 *Assoc.* 1973;63:239-242.
- 491 16. Singh V, Thurman A. How many ways can we define online learning? A systematic literature review
492 of definitions of online learning (1988-2018). *Am J Distance Educ.* 2019;33(4):289-306.
493 doi:10.1080/08923647.2019.1663082
- 494 17. Office of Postsecondary Education. *Distance education and innovation.* Department of Education;
495 2020:54742-54818. Accessed April 1, 2022.
496 [https://www.federalregister.gov/documents/2020/09/02/2020-18636/distance-education-and-](https://www.federalregister.gov/documents/2020/09/02/2020-18636/distance-education-and-innovation)
497 [innovation](https://www.federalregister.gov/documents/2020/09/02/2020-18636/distance-education-and-innovation)
- 498 18. Magda AJ, Capranos D, Aslanian CB. *Online college ctudents 2020: comprehensive data on demands*
499 *and dferences.* Wiley Education Services; :58. [https://universityservices.wiley.com/wp-](https://universityservices.wiley.com/wp-content/uploads/2020/06/OCS2020Report-ONLINE-FINAL.pdf)
500 [content/uploads/2020/06/OCS2020Report-ONLINE-FINAL.pdf](https://universityservices.wiley.com/wp-content/uploads/2020/06/OCS2020Report-ONLINE-FINAL.pdf)
- 501 19. National Council for State Authorization Reciprocity Agreement (NC-SARA). *NC-SARA institution*
502 *survey: perspectives on the pandemic.*; 2021. Accessed March 23, 2022. [https://nc-](https://nc-sara.org/sites/default/files/files/2021-10/Perspectives_PUBLISH_18Oct2021.pdf)
503 [sara.org/sites/default/files/files/2021-10/Perspectives_PUBLISH_18Oct2021.pdf](https://nc-sara.org/sites/default/files/files/2021-10/Perspectives_PUBLISH_18Oct2021.pdf)
- 504 20. Spangler AA, Spear B, Plavcan PA. Dietetics education by distance: current endeavors in caade-
505 accredited/approved programs. *J Am Diet Assoc.* 1995;95(8):925-929.
- 506 21. Benton-King C, Webb D, Holmes Z. Distance education in undergraduate dietetic education. *J Allied*
507 *Health.* 2005;34:36-39.

- 508 22. Hodges C, Moore S, Lockee B, Trust T, Bond A. The difference between emergency remote teaching
509 and online learning. *Educ Rev*. Published online March 27, 2020.
510 [https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-](https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning)
511 [online-learning](https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning)
- 512 23. Rogus S, Martin S, Phillips SG. Teaching in an undergraduate dietetics program and internship during
513 covid-19. *J Fam Consum Sci*. 2021;113(2):25-29. doi:10.14307/JFCS113.2.25
- 514 24. Barbrow EP, Jeong M, Parks SC. Computer experiences and attitudes of students and preceptors in
515 distance education. *J Am Diet Assoc*. 1996;96(12):1280-1281.
- 516 25. McDonnell E, Achterberg C. Development and delivery of a nutrition education course with an
517 electronic mail component. *J Nutr Educ*. 1997;29(4):210-214. doi:10.1016/S0022-3182(97)70200-0
- 518 26. Gaetke LM, Forsythe H, Wesley MM. Dietetics interns at geographically remote supervised practice
519 sites find a listserv to be a useful information sharing tool that fosters independent learning. *J Am*
520 *Diet Assoc*. 2002;102(6):851-853.
- 521 27. Litchfield RE, Oakland MJ, Anderson JA. Improving dietetics education with interactive
522 communication technology. *J Am Diet Assoc*. 2000;100(10):1191-1194.
- 523 28. Litchfield RE, Oakland MJ, Anderson JA. Relationships between intern characteristics, computer
524 attitudes, and use of online instruction in a dietetic training program. *Am J Distance Educ*.
525 2002;16(1):23-36. doi:10.1207/S15389286AJDE1601_3
- 526 29. Farrior ES, Gallagher ML. An evaluation of distance education. *Top Clin Nutr*. 2000;15(4):10-18.
- 527 30. National Center for Education Statistics. Undergraduate enrollment. condition of education.
528 Published online 2022. <https://nces.ed.gov/programs/coe/indicator/cha>.
- 529 31. Radler DR, Touger-Decker R. The bits and bytes to advanced graduate degree programs. *Nutr Clin*
530 *Pract*. 2007;22(6):647-652. doi:10.1177/0115426507022006647
- 531 32. Heuberger R, Clark WA. Synchronous delivery of online graduate education in clinical nutrition. *J*
532 *Allied Health*. 2019;48(1):7.
- 533 33. Raidl MA, Bennett Wood O, Lehman JD, Evers WD. Computer-assisted instruction improves clinical
534 reasoning skills of dietetics students. *J Am Diet Assoc*. 1995;95(8):868-873.
- 535 34. Carew LB, Chamberlain VM, Alster FA. Evaluation of a computer-assisted instructional component in
536 a college-level nutrition course. *J Nutr Educ*. 1997;29(6):327-334. doi:10.1016/S0022-
537 3182(97)70247-4
- 538 35. Turner RE, Evers WD, Bennett Wood O, Lehman JD, Peck L. Computer-based simulations enhance
539 clinical experience of dietetics interns. *J Am Diet Assoc*. 2000;100(2):183-190.
- 540 36. Zubas P, Heiss C, Pedersen M. Comparing the effectiveness of a supplemental online tutorial to
541 traditional instruction with nutritional science students. *J Interact Online Learn*. 2006;5(1):75-81.

- 542 37. Puri R, Bell C, Evers WD. Dietetics students' ability to choose appropriate communication and
543 counseling methods is improved by teaching behavior-change strategies in computer-assisted
544 instruction. *J Am Diet Assoc.* 2010;110(6):892-897. doi:10.1016/j.jada.2010.03.022
- 545 38. Redgate J, Brody R, Marcus AF, Tomesko J, Gomes A, Touger-Decker R. Use of computer-assisted
546 instruction for teaching nutrition-focused physical examination to dietetics students: a pilot study.
547 *Top Clin Nutr.* 2017;32(3):219-228. doi:10.1097/TIN.000000000000109
- 548 39. Ross J, Wright L, Arikawa A. Adapting a classroom simulation experience to an online escape room
549 in nutrition education. *Online Learn.* 2021;25(1). doi:10.24059/olj.v25i1.2469
- 550 40. McKay T, Yakes Jimenez E, Svihla V, Castillo T, Cantarero A. Teaching professional practice: using
551 interactive learning assessments to simulate the nutrition care process. *Top Clin Nutr.*
552 2016;31(3):257-266. doi:10.1097/TIN.000000000000079
- 553 41. Dodds JM, Laraia BA, Carbone ET. Development of a master's in public health nutrition degree
554 program using distance education. *J Am Diet Assoc.* 2003;103(5):602-607.
555 doi:10.1053/jada.2003.50115
- 556 42. Laraia BA, Dodds JM, Benjamin S, Jones SJ, Carbone ET. Can distance education prepare future
557 public health nutritionists? A case study. *J Nutr Educ Behav.* 2008;40(1):34-38.
558 doi:10.1016/j.jneb.2007.04.377
- 559 43. Wright L. Comparison of student outcomes in distance learning versus traditional dietetic
560 internships. *Top Clin Nutr.* 2009;24(3):243-251. doi:10.1097/TIN.0b013e3181b543e8
- 561 44. Litchfield RE, Oakland MJ, Anderson J. Promoting and evaluating competence in on-line dietetics
562 education. *J Am Diet Assoc.* 2002;102(10):1455-1458.
- 563 45. Arts J, Paulin C, Lofgren IE, Woodland B, English C. Evaluation of dietetic interns' research skills in an
564 online, non-thesis master's program. *Top Clin Nutr.* 2020;35(3):277-284.
565 doi:10.1097/TIN.000000000000209
- 566 46. Spiker M, Hege A, Giddens J, et al. Leveraging online learning to promote systems thinking for
567 sustainable food systems training in dietetics education. *Front Nutr.* 2021;8:623336.
568 doi:10.3389/fnut.2021.623336
- 569 47. García-Morales VJ, Garrido-Moreno A, Martín-Rojas R. The transformation of higher education after
570 the covid disruption: emerging challenges in an online learning scenario. *Front Psychol.*
571 2021;12:616059. doi:10.3389/fpsyg.2021.616059
- 572 48. Regmi K, Jones L. A systematic review of the factors – enablers and barriers – affecting e-learning in
573 health sciences education. *BMC Med Educ.* 2020;20(1):91. doi:10.1186/s12909-020-02007-6
- 574 49. Vaona A, Banzi R, Kwag KH, et al. E-learning for health professionals. Cochrane Effective Practice and
575 Organisation of Care Group, ed. *Cochrane Database Syst Rev.* 2018;2018(8).
576 doi:10.1002/14651858.CD011736.pub2

- 577 50. Sahu PK, Dalcik H, Dalcik C, et al. Best practices for effective implementation of online teaching and
578 learning in medical and health professions education: during COVID-19 and beyond. *AIMS Public*
579 *Health*. 2022;9(2):278-292. doi:10.3934/publichealth.2022019
- 580 51. National Council of State Boards of Nursing. *Nursing regulation recommendations for distance*
581 *education in Prelicensure nursing programs.*; 2015:1-12. Accessed July 31, 2022.
582 https://www.ncsbn.org/15_DLC_White_Paper.pdf
- 583 52. Authement RS, Dormire SL. Introduction to the online nursing education best practices guide. *SAGE*
584 *Open Nurs*. 2020;6:237796082093729. doi:10.1177/2377960820937290
- 585 53. Elshami W, Taha MH, Abdalla ME, Abuzaid M, Saravanan C, Al Kawas S. Factors that affect student
586 engagement in online learning in health professions education. *Nurse Educ Today*.
587 2022;110:105261. doi:10.1016/j.nedt.2021.105261
- 588 54. Siah CJR, Huang CM, Poon YSR, Koh SLS. Nursing students' perceptions of online learning and its
589 impact on knowledge level. *Nurse Educ Today*. 2022;112:105327. doi:10.1016/j.nedt.2022.105327
- 590 55. Stocker BL. Transitioning from on-campus to online in a master of science nursing program: a
591 comparative study of academic success. *Am J Distance Educ*. 2018;32(2):113-130.
592 doi:10.1080/08923647.2018.1443371
- 593 56. Pei L, Wu H. Does online learning work better than offline learning in undergraduate medical
594 education? A systematic review and meta-analysis. *Med Educ Online*. 2019;24(1):1666538.
595 doi:10.1080/10872981.2019.1666538
- 596 57. Tudor Car L, Poon S, Kyaw BM, et al. Digital education for health professionals: an evidence map,
597 conceptual framework, and research agenda. *J Med Internet Res*. 2022;24(3):e31977.
598 doi:10.2196/31977
- 599 58. U.S. Department of Homeland Security. Study in the states. frequently asked questions.
600 <https://studyinthestates.dhs.gov/tools-menu/frequently-asked-questions>
- 601 59. Research and Markets. *Global online education market - forecasts from 2020 To 2025.*; 2020.
602 Accessed May 1, 2022. [https://www.researchandmarkets.com/reports/4986759/global-online-](https://www.researchandmarkets.com/reports/4986759/global-online-education-market-forecasts-from)
603 [education-market-forecasts-from](https://www.researchandmarkets.com/reports/4986759/global-online-education-market-forecasts-from)
- 604 60. Intelligent. Best online master's in nutrition programs of 2022. Accessed May 1, 2022.
605 <https://www.intelligent.com/best-online-masters-in-nutrition-degree-programs/>
- 606 61. Border K, Endrizal C, Cecil M. Academy of nutrition and dietetics: revised 2018 standards of
607 professional performance for registered dietitian nutritionists (competent, proficient, and expert) in
608 education of nutrition and dietetics practitioners. *J Acad Nutr Diet*. 2019;119(1):124-136.e29.
609 doi:10.1016/j.jand.2018.10.014
- 610 62. Paul K. Biden plans to spend \$100 bn to bring affordable internet to all americans. *Guardian*.
611 [https://www.theguardian.com/us-news/2021/mar/31/joe-biden-infrastructure-plan-affordable-](https://www.theguardian.com/us-news/2021/mar/31/joe-biden-infrastructure-plan-affordable-internet)
612 [internet](https://www.theguardian.com/us-news/2021/mar/31/joe-biden-infrastructure-plan-affordable-internet). Published April 1, 2021. Accessed April 30, 2022.

- 613 63. B. Means, Y. Toyama, R. Murphy, M. Bakia, K. Jones. *Evaluation of evidence-based practices in online*
614 *learning: a meta-analysis and review of online learning studies*. U.S. Department of Education;
615 2010:94. Accessed February 10, 2022. [https://www.sri.com/publication/education-learning-](https://www.sri.com/publication/education-learning-pubs/digital-learning-pubs/evaluation-of-evidence-based-practices-in-online-learning-a-meta-analysis-and-review-of-online-learning-studies/)
616 [pubs/digital-learning-pubs/evaluation-of-evidence-based-practices-in-online-learning-a-meta-](https://www.sri.com/publication/education-learning-pubs/digital-learning-pubs/evaluation-of-evidence-based-practices-in-online-learning-a-meta-analysis-and-review-of-online-learning-studies/)
617 [analysis-and-review-of-online-learning-studies/](https://www.sri.com/publication/education-learning-pubs/digital-learning-pubs/evaluation-of-evidence-based-practices-in-online-learning-a-meta-analysis-and-review-of-online-learning-studies/)

Journal Pre-proof

Distance Education in Nutrition and Dietetics Education over the last 30 Years: A Narrative Review

Table 1. Search terms used to identify articles for inclusion in the narrative review.

Dietetic Education	Online Education	Higher Education
Dietetics; dietetic	Online learning; Online courses	Colleges and universities
Nutrition education	Distance teaching; Distance learning; Distance education (or Education, Distance)	Graduate; Graduate education; Education, Masters; Graduate study
	E-learning; Electronic learning	Undergraduate; Undergraduate education; Undergraduate students
	Computer-assisted education; Computer-assisted instruction; Computer-assisted learning	Vocational education
	Correspondence courses	Education, Professional
	Internet-based education	Continuing education
	Electronic mail	Internship; intern
		Coordinated program
		Didactic program

Table 2. Summary of articles about distance education in nutrition and dietetics education in chronological order by theme (N=25)			
Reference Publication Year Article Type Study Type/Design	Purpose	Target or Study Population (n=)	Brief Summary M=Methods, R= Results, D= Discussion and L=Limitations
<i>Distance Education Then and Now</i>			
Spangler, A.A. et al. (1995) ²⁰ Report	To describe the current use of distance education in dietetics education programs accredited/approved by CAADE, with particular emphasis on the use of advanced information technologies.	Annual Directory of Dietetics Programs 1994-1995 (n=591 program directors) and 1995-1996 (n=354 program directors) which included undergraduate and graduate programs.	M: Program directors were contacted and asked whether distance learning was available in their dietetics education programs. R: 37 program directors indicated that distance education was available in their programs. Common delivery formats of distance learning included correspondence courses, audioconferencing, video teleconferencing and televised classes or presentations. D: Findings indicated that many courses are available by distance education in both undergraduate and graduate programs. L: Subjective information from program directors may produce bias.
Barbrow, E.P. et al. (1996) ²⁴ Research and professional brief	This study builds and expands on past research studies in designing a technology-based dietetics distance education program. The overall research questions address differences in computer experiences and attitudes between	Students (n=615) and preceptors (n=621) enrolled in dietetics distance education program.	M: Self-administered questionnaire was sent to all students and preceptors enrolled in dietetics distance education program. The study had 3 aims: identify students' and preceptors' accessibility to computers at work; examine their experience level with computer software at work; and examine the effects of sociodemographic variables on students' and preceptors' attitudes toward using computers. R: 46% and 47% response rate from students and preceptors, respectively. Computer accessibility at home or work was 71% for students and a78% for preceptors. Word processing programs were the software with which respondents had the most experience; nutrient analysis and spreadsheet software followed. Respondents' overall attitudes toward computers were

	students and preceptors.		<p>relatively positive with the exception of time available to learn new software. Respondents' age, and type and size of work setting did not appear to affect computer attitudes of students or preceptors.</p> <p>D: Respondents experiences with and attitudes toward using computers did not seem to be a barrier to implementing interactive computer systems in distance education.</p> <p>L: Subjective information which may introduce bias.</p>
McDonnell E. & Achterberg C. (1997) ²⁵ Report	The report describes the development and delivery of a distance education course in nutrition with an electronic mail component.	Students, nutrition majors, enrolled in a nutrition education course (n=9) at Penn State University.	<p>M: The course was modeled after a traditional classroom course. The distance version was piloted with nine students. It included a print study guide, written assignments, and an e-mail component. The email component allowed for discussion among students without face-to-face meetings.</p> <p>R: Student achievement was high on the course assignments and exam. Students reported favorable reactions to the course content, the course delivery method, and the e-mail interaction.</p> <p>D: This report presents a model for nutrition educators to provide effective education to geographically dispersed audiences.</p> <p>L: Small sample size.</p>
Farrior E. & Gallagher M. (2000) ²⁹ Research Prospective Cohort Study	To examine the process by which graduate nutrition courses offered via the Internet are created and evaluated.	Dietetic interns and nutrition master's students (N=51) in the Department of Nutrition and Hospitality Management at East Carolina University in Greenville, NC.	<p>M: Used Blackboard to replace graduate level nutrition courses with online delivery.</p> <p>R: Student feedback obtained via online questionnaire. Enrollment increased in two courses (Research in Clinical Nutrition and Current Issues) by 15%. Course assignments were good or better based on instructor observation in online course compared to in-person courses. Student course evaluations had a low response rate (25-87%). Interaction with students (2.5) and instructor (4.3) received low ratings in courses without interactive chat room/office hours, or discussion boards.</p>

			<p>D: Benefits of online course delivery realized, promoting interaction between students and between students and instructor deemed important. Linking distance students to campus resources is an important piece of supporting online learning. Did not collect data on whether performance of students was similar or improved in online versus in-person classes.</p> <p>L: Did not collect data on whether performance of students was similar or improved in online versus in-person classes. Small sample size from one specific program.</p>
<p>Litchfield, R. et al. (2000)²⁷</p> <p>Research</p> <p>Pilot Study/Prospective Cohort Study</p>	<p>To evaluate a model of learner-centered, cooperative distance education based on interactive online technology.</p>	<p>Dietetic interns (N=8) from the Iowa State Dietetic Internship Program</p>	<p>M: Success of a distance-based DI using WebCT was evaluated by reviewing students' clinical competency on key feature exams, computer attitudes surveys, exit interviews, and first-time performance on the registration exam.</p> <p>R: Significant improvement occurred in comfort using the internet (p=0.010). Quiz scores improved during the internship but were not significant except for the renal module (p=0.001).</p> <p>D: If there is an opportunity for online instruction dietetic interns will utilize it and continued use should be explored.</p> <p>L: Were unable to come to conclusions regarding impacts on registration examination performance. Quiz scores were not a good measure of clinical competency. Very small sample size from one specific program.</p>
<p>Gaetke, L. et. al. (2002)²⁶</p> <p>Research</p> <p>Prospective Cohort Study</p>	<p>To evaluate an electronic listserv used by dietetic interns at remote sites during their supervised practice experience.</p>	<p>Dietetic interns (N=29) from both the Coordinated Program in Dietetics and Dietetic Internship Program at the University of Kentucky (1999-2000).</p>	<p>M: Listserv was used to facilitate online journal club with discussion and problem-based assignments, as well as communication between students, faculty, and preceptors.</p> <p>R: Results of dietetic intern surveys showed the listserv was a positive experience for information sharing (59% strongly agreed, 38% agreed), fostered independent learning (35% strongly agreed, 56% agreed), intern learned from the discussion (28% strongly agreed, 55% agreed), and the articles provided an overview of critical issues (24% strongly</p>

			<p>agreed, 55% agreed). Year 2 students were more likely to agree that the listserv was an effective instructional strategy and that they learned from the listserv. Year 2 interns also needed less supervision per faculty.</p> <p>D: A listserv can provide an opportunity for learning, teaching, and communication between dietetic interns in supervised practice rotations. Future research comparing experiences across program types and evaluating faculty time spent online monitoring these tools is warranted.</p> <p>L: Small sample size from one specific program.</p>
<p>Litchfield, R. et al. (2002)²⁸</p> <p>Research</p> <p>Prospective Cohort Study</p>	<p>To examine the attitudes of dietetic interns towards the use of computers and technology when using online instruction in a DI program.</p>	<p>Dietetic interns (N=75) from three different Dietetic Internship programs (Iowa State, Kansas State, and East Carolina University).</p>	<p>M: Cooperative learning strategies via online instruction using WebCT were incorporated into three internship rotations (nutrition support, pediatric nutrition, and renal nutrition). Attitudes towards the use of computers and technology were examined.</p> <p>R: Interns that preferred working collaboratively used online instruction opportunities more often (p=0.05). Use of online instruction was not influenced by previous intern computer experience or demographics. The time spent using online instruction positively impacted overall attitudes towards computer use. Significant improvement in using the internet occurred regardless of whether online instruction was available.</p> <p>D: The amount of time spent using computers may have the greatest impact on computer attitudes. Many findings did not reach a level of statistical significance. A longer intervention period may have been favorable.</p> <p>L: Many findings did not reach a level of statistical significance. Small sample size, longer intervention period may be more favorable to gather additional data.</p>
<p>Benton-King, C et al. (2005)²¹</p>	<p>To examine the use of distance education in</p>	<p>Directors of CAADE accredited</p>	<p>M: Survey of all directors of dietetic programs (coordinated and didactic) to determine current and future use of distance education technologies in their programs.</p>

	undergraduate dietetic education programs and the opportunities for obtaining an undergraduate degree in dietetics solely via distance education.	undergraduate programs (N=279)	<p>R: Approximately 32% (n = 150, 54% response rate) of undergraduate dietetics programs offer distance education courses in some format. The most common distance education format utilized in dietetics was 100% Internet courses (48%). The most common distance education dietetics course offered was a basic or introductory nutrition course (31%).</p> <p>D: As the size of the institution increased more likely to offer distance education courses. This was also true for DPD programs. From the data of courses offered, or permitted to be transferred, it would not be possible for a student to complete an undergraduate degree in dietetics solely via distance education methodologies at the time this study was conducted. No single institution was found to offer a complete undergraduate degree program in dietetics solely online.</p> <p>L: Availability of distance education courses constantly changing, not able to examine 100% of undergraduate dietetics programs participation in distance education.</p>
Radler, et al. (2007) ³¹ Invited Review	This paper focused on advanced-degree academic programs using the distance education route. Characteristics of technologically savvy programs and learners were addressed.	Advanced degree academic programs using the distance education route.	Distance learning programs provide opportunities for working professionals to seek advanced degrees in a flexible manner. Barriers such as strict schedules, personal or professional responsibilities, the inability to be away from home during the evenings or on weekends, or the lack of a program within a reasonable driving distance are removed with online programs. Students in rural areas or remote parts of the world are not restricted from going to school by their geographic location. Prospective students should evaluate whether they possess the skills and resources to successfully complete advanced degree courses online. The successful online learner must be proficient in computer use. Online learning requires a significant amount of independent learning time, flexibility, and self-discipline.

<p>Heuberger, R. and Clark, W.A. (2019)³²</p> <p>Research Survey</p>	<p>To evaluate perceived differences in the perceptions and opinions of graduate clinical nutrition students related to mode of delivery (synchronous, asynchronous or hybrid) for online graduate clinical courses.</p>	<p>Current or former clinical nutrition graduate students (n=537), convenience sample (32.8% response rate for total n= 176)</p>	<p>M: Pilot tested and validated Qualtrics survey was disseminated via email</p> <p>R: Students perceived synchronous delivery mode to have significant benefits due to enhanced learning, accommodation of different learning styles, interactivity, and connectedness to peers and professors. Graduates showed improvements in synthesis of information, professional competency and future ability to work as an effective part of the healthcare team based on results of triangulated assessment and evaluation of the e-portfolio, oral comprehensive evaluation and capstone experiences.</p> <p>D: Perceptions and opinions of clinical graduate students related to mode of delivery varied and were dependent on individual learning style. Clinicians returning to obtain a MS degree preferred synchronous delivery due to its more structured approach and ability to foster interactivity and connectedness in real time.</p> <p>L: convenience sample, small sample size</p>
<p>Rogus, S., Martin, S. and Phillips, S. (2021)²³</p> <p>Report</p>	<p>Discussion of challenges and solutions discovered by an undergraduate and graduate dietetics program during COVID-19 (shift to online).</p>	<p>Students enrolled in undergraduate and graduate dietetics program at New Mexico State University (NMSU)</p>	<p>Numerous solutions detailed in response to challenges faced during COVID-19 in shifting from F2F to online course delivery for both undergraduate dietetics program and combined master's program and dietetic internship. Faculty received training on NMSU's LMS Canvas which included advanced tools such as Zoom and Respondus Monitor. Faculty became creative and made adaptations i.e. rethinking assignment format, changing grading and late work policies and providing additional resources to students. COVID-19 forced innovation and experience with online delivery methods and while faculty and students adapted, the adopted methods need to be evaluated for academic outcomes and preparedness of students for dietetics practice.</p>

<i>Effects of Computer-Assisted Instruction on Learning</i>			
Raidl, M.A. et al. (1995) ³³ Research	The effects of a computer assisted instruction tutorial program on learning clinical reasoning skills	Undergraduate diet therapy students enrolled in a coordinated program in dietetics (CPD) or a didactic program in dietetics (DPD) (n=413).	M: After completion of lectures on CVD, subjects were given the drill-and-practice program plus a simulation test (group 1), the tutorial plus a simulation test (group 2) or the simulation test only (group 3). R: Scores on simulation test were compared. Group 2 scored higher on the simulation test than group 1 or 3. D: A computer tutorial program enhanced clinical reasoning skills in undergraduate dietetics students. L: Limited tutorial on one subject area.
Carew L.B. et al. (1997) ³⁴ Research	The effectiveness of computer-assisted instruction (CAI) in nutrition education was evaluated to determine association with higher cognitive achievement test scores. Students' opinions concerning the helpfulness, advantages, and disadvantages of such a program were also assessed.	Student enrolled in an introductory nutrition course (n=243). Only introductory nutrition course, required of all majors in nutrition.	M: CAI program was available to 243 students in four sections of an introductory nutrition course. Students could use the CAI program for any amount of time. A valid and reliable cognitive pretest-post-test, an attitude assessment, and a demographic and opinion questionnaire were used. R: There were 160 users and 83 nonusers. Users of the CAI program had higher pretest-post-test gain scores than nonusers. Eighty-seven percent of the students thought that the program was useful or very useful; 78% thought that it improved their grades. Students' attitudes were positive toward use of computers and, generally, improved with use of the program. D: Class material in a computerized format available on disks and a network is useful for improving performance of students in a college-level, introductory nutrition course. L: Information collected using opinion questionnaire may contribute to bias.
Turner, R. et al. (2000) ³⁵ Research	To evaluate whether computer-based simulations impact dietetic intern performance in clinical rotations.	Dietetic interns (N=108) from 8 different programs.	M: During orientation, interns used either a simulation program on 3 case simulation patients (experimental group) or a computer-based tutorial (control group). R: Intern performance on nutrition care skills (31 total) were evaluated during their first on-site clinical rotations by clinical preceptors on a Likert scale. There were no

Prospective Cohort Study			<p>differences in the overall evaluation of the groups. Interns that started clinical rotations immediately after orientation were rated lower than those who had started later. The rate of improvement in performance was greatest in most categories for interns who used the care planning simulation system.</p> <p>D: No consistent, clear differences in overall performance were noted between groups. Students with simulated patient experience may more quickly understand and develop nutrition assessment techniques and procedures when moved into on-site clinical rotations. Simulation may allow interns to progress more rapidly and spend more time with independent patient interaction. Unable to control factors related to the diversity of intern background, work experience, etc. between groups.</p> <p>L: Unable to control factors related to the diversity of intern background, work experience, etc. between groups.</p>
Zubas, et al. (2006) ³⁶ Research Quasi-experimental	The purpose of this study was to ascertain if an online computer tutorial on diabetes mellitus, supplemented to traditional classroom lecture, was an effective tool in the education of nutrition students.	Thirty-one nutrition majors enrolled in a senior level clinical nutrition course at California Polytechnic State University, San Luis Obispo, participated in the study.	<p>M: A comprehensive web-based tutorial on diabetes mellitus was developed by a group of faculty members and graduate students at California Polytechnic State University, San Luis Obispo. Students were randomly assigned to learn a unit on diabetes in one of two ways: (1) through an online diabetes tutorial plus classroom lecture (treatment group, n=10) or (2) via classroom lecture alone (control group, n=12). Fifty-item multiple choice pre- and post- tests were administered to all students.</p> <p>R: Post-test scores were significantly higher than pre-test scores for the entire sample, with a mean improvement of 7.0 ± 4.6 points. The improvement of the lecture plus tutorial group (n=10) was significantly greater (p=.04) than for the lecture only group (n=12).</p> <p>D: Students completing a web-based tutorial as a supplement to classroom lecture displayed greater improvement in pre- vs. post-test scores compared with students who attended</p>

			<p>lecture only. Students completing the tutorial indicated a favorable attitude toward computer supplemented instruction.</p> <p>L: Limitations of this study included the small sample size, reducing statistical power and generalizability of results and the fact that results may be different for a different instructor providing the lecture on diabetes. In addition, practical application of the knowledge learned from the tutorial was not tested using the pre- and post-tests.</p>
<p>Puri, et al. (2010)³⁷</p> <p>Research</p> <p>Quasi-experimental design</p>	<p>This study used computer-assisted instruction (CAI) simulations of RD client communications to examine whether students who worked through the CAI modules would choose more appropriate counseling methods.</p>	<p>Eleven didactic programs participated. A total of 350 students were in the intervention group and 102 students were in the control group.</p>	<p>M: This study used CAI simulations of RD client communications to examine whether students who worked through the CAI modules would choose more appropriate counseling methods. Modules were created based on information from experienced RD. They contained videos of RD-patient interactions and demonstrated helpful and less helpful methods of communication. The intervention group of students received a pretest module, two tutorial modules, and a posttest module. The control group only received the pretest and posttest modules. Data were collected during three semesters in 2006 and 2007.</p> <p>R: Pretest scores were not different. The intervention group's posttest score was higher than its pretest score. Change in score from pretest to post-test was higher for the intervention group.</p> <p>D: This study supports the supplemental use of CAI in teaching communication and counseling methods to dietetics students. The CAI tutorial modules improved students' abilities to choose the best communication and counseling approaches.</p> <p>L: A limitation of the study was that only the instructors who opted to use the modules and only those programs with 25 students per class were included. It is not clear whether smaller class sizes and/or the use of a greater number of programs would have affected the results. Another</p>

			limitation was that the modules were not created to address multicultural differences in patient counseling. The actors shown in the modules were not chosen to provide diversity of ethnicity or culture. Whether students would have learned more if the patients had been more diverse is a question that should be explored.
McKay T. et al. (2016) ⁴⁰ Research	Online Interactive Learning Assessments (ILAs) were pilot tested to teach the NCP in an undergraduate nutrition course at a state university.	Undergraduate students enrolled from an August-December 2013 Nutrition through the Lifecycle semester-long course (n=30).	M: Online Interactive Learning Assessments (ILAs) were pilot tested as a way to teach the NCP in an undergraduate nutrition course at a state university. R: Participating students were satisfied with the ILAs and reported that they provided the feel of authentic practical experience with the NCP. As measured by examination performance, students had similar mastery of content knowledge introduced via ILAs versus lecture. D: ILAs may allow students to gain content knowledge and effective professional practice skills. L: Small sample size using 1 course.
Redgate, J. et al. (2017) ³⁸ Research Pilot Study/Retrospective Design	To assess change in dietetic students' knowledge related to nutrition focused physical examination (NFPE) utilizing an online computer-assisted (CAI) delivered via Moodle, a web-based learning management system (LMS).	Undergraduate dietetic students enrolled in an online Coordinated Program (CP), convenience sample (n=22)	M: Pre/Post-test evaluation of 8-week online NFPE CAI Module via Moodle which included live virtual classroom sessions, multi-media presentations, online discussion forums and case studies R: Significant increase in knowledge scores across all content areas for all participants who completed both the pre and post-test knowledge assessment (21/22). Largest increase in mean percentage scores in functional status (50% increase) and fat wasting (25.8%). Positive student evaluations of module related to motivation to learn and confidence in ability to practice NFPE. D: The results of this pilot study support the feasibility of CAI as a means to increase dietetics students' knowledge of NFPE.

			L: small convenience sample, lack of control group, pre/post test not tested for reliability, construct validity limited, higher quality images for fat and muscle wasting needed.
Ross, J., Wright, L., and Arikawa, A. (2021) ³⁹ Research Case Study	To describe the adaptation of a classroom simulation experience to an online escape room in nutrition education.	Undergraduate class in nutrition and dietetics program - senior dietetic students (n=53)	M: Online escape room (simulation-based learning or SBLE) designed to replicate a face to face (F2F) classroom simulation experience using the Nutrition Care Process (NCP) was described. The NCP step by step progression was organized into nine modules within a learning management system (LMS). Quizzes were imbedded in all modules (except 3 and 7) and required a score of 100% to unlock next step. Debriefing took place after all students escaped the final (9th) step. (50/53 students participated). R: Students reported a positive first impression of the assignment, that they felt they had the knowledge and skills needed to complete it, found the flow/process mimicked real practice and appreciated the immersive nature of the videos. Some technology and clinical challenges were described. Speedy completion tracked by LMS analytics suggested need for more layered and complicated criteria and varied assignments in the future to challenge the students to think critically. D: Overall, the online escape room proved to be an innovative and effective learning strategy. L: First time offering this course, no ability to compare to F2F, lack of in-depth qualitative measures, no control group
<i>Outcome Assessment Using Distance Education</i>			
<i>Program Development and Program Outcomes</i>			
Dodds, J. et al. (2003) ⁴¹ Perspective in Practice Article	To outline four key steps used to implement a master's in public health nutrition degree primarily	Two cohorts of students from 1996 to 1998 (n=9, n=5) throughout North Carolina enrolled in	M: A pilot distance learning graduate program at UNC Chapel Hill. R: This report demonstrates the feasibility of offering an existing graduate degree program in public health nutrition to students unable to relocate by including distance education technologies in the curriculum.

Mixed Methods Analysis	using distance education at the University of North Carolina.	the distance education program.	<p>D: This project identified four key steps: (a) conduct a detailed market analysis;(b) establish an infrastructure to deliver the program; (c) tailor the curriculum using the technology; and (d) identify, accommodate, and develop student capabilities. The findings indicate that distance education strategies are appropriate to carry out a full MPH curriculum in nutrition, but sufficient enrollment is necessary to cover the added curriculum expenditures.</p> <p>L: Although this program demonstrated the ability to offer an MPH in nutrition in a distance education format, there were not enough potential students in the three-state region to sustain such a program. Thus, the program needs to be offered to a larger geographic region to recruit and admit the numbers necessary to make the program financially feasible.</p>
Laraia, et al. (2008) ⁴² Research Brief Case Study	To assess student retention, readiness, support and outcomes among students completing the Professional Practice Program in Nutrition (PPP)	Course grades, grade point averages, and comprehensive exam results compared 10 PPPN students from 2 cohorts and 72 residential students from 3 cohorts.	<p>M: The Professional Practice Program in Nutrition was a 3-year, pilot public health nutrition master's (MPH) degree curriculum using distance education (DE) strategies. Qualitative evaluation using semi-structured, in-depth interviews conducted with PPPN graduates.</p> <p>R: Qualitative findings revealed that PPPN students were highly motivated, sought out the MPH and initially had great support from family and employers; however, support from employers waned over time. Although several challenges to continued enrollment confronted PPPN students, those who completed the MPH all advanced in the workplace. Course grades and grade point averages were similar between the 2 groups. Students in the PPPN were more likely than residential students to retake the comprehensive exam.</p> <p>D: The findings indicate that DE strategies were suitable to deliver an MPH curriculum in nutrition. The majority of PPPN graduates experienced job advancement and demonstrated leadership development.</p> <p>L: Small sample size in PPPN distance program.</p>

<p>Wright (2009)⁴³</p> <p>Research</p> <p>Mixed Methods</p>	<p>The purpose of this project was to compare student outcomes in distance learning (DL) dietetic internships with student outcomes in traditional (TR) dietetic internships. It was hypothesized that there would be equivalency in student outcomes between the 2 types of internship programs.</p>	<p>The participants of this project were the directors of DL and TR dietetic internships. Graduates from the past 3 years of the participating internships, and the first supervisors after graduation of those completing the pro-grams. All 11 DL dietetic internship directors were asked to participate, and 5 agreed to participate. Seven TR programs agreed to participate.</p>	<p>M: Outcomes of distance learning (DL) versus traditional (TR) dietetic internships were compared by program pass rates on the registration examination for dietitians and surveys and interviews on graduates' preparedness for practice. A total of 345 surveys were mailed, with a total of 12 surveys returned.</p> <p>R: Overall, TR graduates ranked themselves significantly higher on their ability to communicate, ability to provide nutrition therapy, clinical judgment, independence, and work ethic. There was no significant difference between graduates on the ability to counsel patients and ability to manage foodservice systems.</p> <p>D: The results of this project did not support equivalency in preparation between DL and TR dietetic internships. Traditional internship graduates and their supervisors rated themselves/graduates significantly higher in most constructs of preparedness, which was confirmed by interview themes. Graduates of TR dietetic internship were perceived to be prepared at an advanced level.</p> <p>L: The limitations of this study include a very small sample size, a low response rate, and the administration of non-validated surveys. In addition, the ratings on preparation were self-perceived and there was the potential of un-documented differences among groups. The qualitative data provided additional information in this project and the number of super-visors was limited to 6 responders.</p>
<p><i>Student Learning Outcomes</i></p>			
<p>Litchfield, R. et al. (2002)⁴⁴</p> <p>Research</p>	<p>To examine whether the use of a key-feature exam administered via online technology can develop</p>	<p>Dietetic interns (N=75) from three different Dietetic Internship programs (Iowa State, Kansas State, and East</p>	<p>M: Divided interns into those with (n=44) and those without (n=31) online instruction and administered two key-feature exams in a pre- and post-test model to both groups. Interns with online instruction completed three separate online modules specific to nutrition support, pediatric nutrition, and renal nutrition.</p>

Prospective Cohort Study	competency of students in a dietetic internship program.	Carolina University).	<p>R: Interns with online instruction had greater improvement ($p<0.05$) on specific portions of key-feature exams (I.e. nutrition support and pediatric nutrition). Both groups significantly improved on the nutrition support calculations, but there was no statistical difference between groups. There were no statistical differences in performance on the registration exam scores between groups as of March 2001. GPA had a significant positive relationship with change in nutrition support calculations score ($p<0.03$), and post-test scores on the nutrition support calculations test had a significant, positive association with registration exam scores ($p<0.01$).</p> <p>D: The key-feature exam may be a valuable tool in dietetics education, and online technology may enhance performance on such exams, particularly those related to nutrition support calculations. Post-test scores on nutrition support calculations tests may be predictive of future success on the registration exam. Findings may not be relatable to current exam preparation requirements.</p> <p>L: Small sample size. The registration exam has since been updated, so findings may not be relatable to current exam preparation requirements.</p>
Arts, J. et al. (2020) ⁴⁵ Research A pre/post, single-group design	To determine the impact of a 4-course research curriculum on the topic of research skills of students enrolled in a 100% online, non-thesis master's program. A secondary aim was	Students enrolled in online MS Dietetics Program at URI, 2 cohorts: class of 2015-2016, class of 2016-2017 (n=55)	<p>M: Pre and Post validated survey use to evaluate a 4-course research curriculum. students self-evaluated research skills and interest in research.</p> <p>R: Significant improvements shown in 8/11 research skills in both introductory and advanced research skills. Students' self-reported ability to analyze data was thought to be related to use of statistical analysis program (SPSS) in two of the four research courses. Students' showed an unexpected but nonsignificant decrease in interest in 8 of the 11 research skills. This finding may be due to small sample.</p>

	to evaluate students' interest on the topic.		<p>D: Online non-thesis master's program that included a 4-course research curriculum was effective in improving students' perceived research skills.</p> <p>L: Use of self-assessment, students' prior exposure to research not assessed, small sample size</p>
Spiker, M et al (2021) ⁴⁶ Pilot Test	To share how food systems educators can utilize online learning to effectively equip students with higher order learning skills, such as system thinking to address the complexities of sustainable food systems.	Multi-site cohort of dietetic interns and coordinated graduate students (n=140) from Iowa State, Oregon Health & Science University, Northern Illinois University and the University of Kentucky.	<p>M: Two interactive webinar series (consisting of training webinar, a practice activity, and a synthesis webinar) were developed by a working group convened by the Academy of Nutrition and Dietetics Foundation (as part of Future of Food Initiative) and pilot-tested at four university sites.</p> <p>R: Direct assessment of student learners was provided by subject matter experts and educators across the two series. Learners demonstrated several dimensions of systems thinking i.e. ability to recognize interconnections between system components, understanding systems at different scales and using conceptual models to represent complexity. Indirect assessment by learners demonstrated more consistent confidence in ability to perform the learning outcomes based on post-test scores. Learners provided feedback on what worked well and areas for improvement.</p> <p>D: The online platform provided a means to provide transdisciplinary education in sustainable food systems that demonstrated benefits for both food systems educators and future food systems professionals.</p> <p>L: webinar series was optional, low response rate on pre/post surveys, most sites mid-semester implementation.</p>

Distance Education in Nutrition and Dietetics Education over 30 Years: A Narrative Review

Figure 1. Screening process to identify articles describing distance education in nutrition and dietetics education in the U.S.

