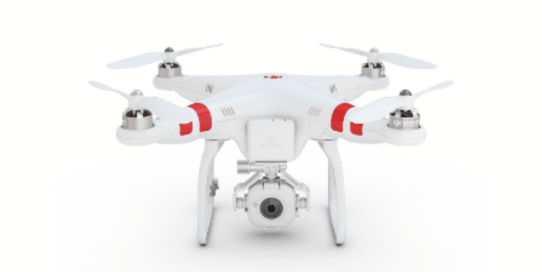
Morningside College Summer Undergraduate Research Program

Teaching with Unmanned Aerial Vehicles: Perceptions of Iowa Agricultural Education Teachers



Retrieved from: https://giphy.com/search/drone

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Introduction

General Use of UAVs:

- Began with military application, increased to businesses and commercial application (Scarcella, 2016)
- Border and port security, homeland surveillance, scientific data collection, cross-country transport, and telecommunication services (McCarley, Wickens, 2004)
- By 2026
  - 100,000 new jobs
  - $82 billion impact in the US
  - 1208 new jobs in Iowa (Scarcella, 2016)

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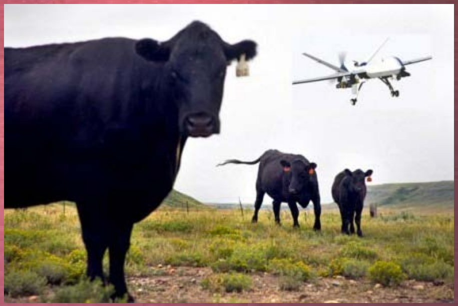
Introduction

Agricultural Use of UAVs:

- Field trials
- Research
- Biomass
- Crop growth monitoring
- Food quality
- Precision farming
- (Grendorffer, Engel, Teichert, 2008)

Retrieved from: http://dronereview.com/2016/09/15/multirotors-prevail-in-agriculture/



Retrieved from: http://agrisk.umd.edu/blog/privacy-and-the-use-of-drones/

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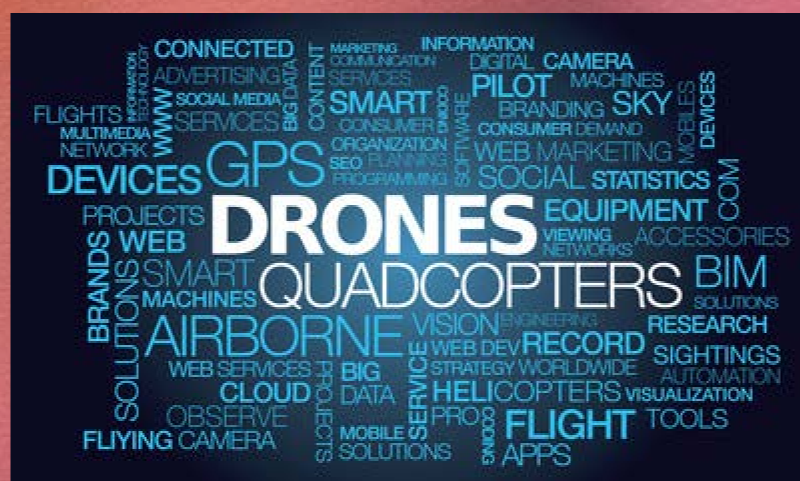
Introduction

Educational Use of UAVs in STEM/Agriculture:

- Can inspire critical thinking, problem solving, and creativity (Carnahan, Crowley, & Hummel, 2016)

- "The time has come for pioneers in Science, Technology, Engineering, and Math (STEM) integration and technology education to utilize this cutting-edge tool as both a topic and instructional device in K-12 education," (Preble, 2015, p. 24)



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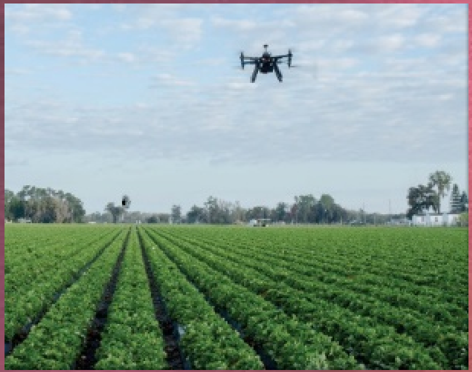
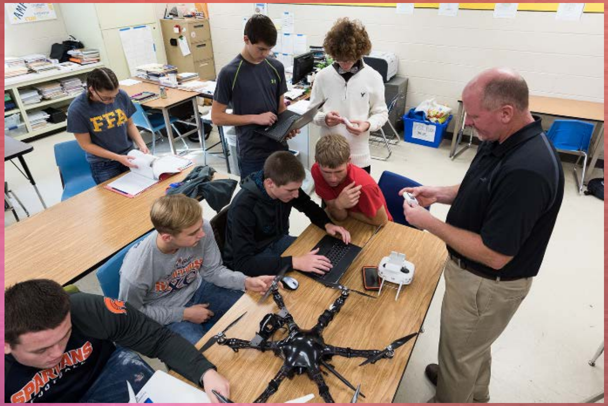
Need for Study



Retrieved from: http://farmflavor.com/florida/drones-farming-future/

- A need for curriculum development, teaching strategies, and teacher training in the use of UAVs in STEM is evident (Preble, 2015)



Retrieved from: https://www.ffanewhorizons.org/2017/03/01/take-off/

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Theoretical Framework

- Through Bandura's (1997) Self-Efficacy Theory, we wanted to determine teacher's level of capacity to teach

- Self-efficacy is one's capability to execute actions necessary to achieve a desired level of performance (Bandura, 1997)

- Self-efficacy is gained:
  - Through mastery experiences
  - Seeking similar people to oneself
  - Social persuasion
  - Physiological and emotional arousal (Bandura, 1997)

- The higher the teachers' self-efficacy, the more likely they are to include in the curriculum

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Purpose and Objectives

Determine the perceptions of Iowa secondary agriculture teachers regarding the teaching of UAV technology

1. Describe respondents' **perceived level of importance** regarding teaching UAV-related content in the agricultural education program.
2. Describe the **perceived level of capability to te**ach UAV-related content in the agricultural education program.
3. Describe the **discrepancy between the importance** of UAVs in agricultural education **and capability to teach** UAV-related content as perceived secondary agricultural education teachers.

Methods

- Literature review over UAV-related educational issues
- Developed a survey instrument using Qualtrics (Dillman *et al*., 2014)
- Panel of experts in Agriculture Mechanics education reviewed to establish validity and provide feedback
- Pilot tested with Nebraska SBAE instructors for reliability and feedback (N=186, n=66)
- Each construct demonstrated *Excellent* reliability

  (George & Mallory, 2003)
  - Importance Construct (α = .903)
  - Capacity to Teach Construct (α = .977)

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Methods

- Instrument sent to Iowa SBAE instructors (N= 229)
    - 117 responses for a 51% response rate
- WMDS = difference between perceived importance and capacity to teach scores, weighted by importance (Borich, 1997)
- Completed 14 qualitative interviews
- Interviews were recorded, transcribed, and will be open coded to determine themes (Saldaña, 2013)

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Respondent Demographics

Summary of Respondents' Demographic Characteristics

	f	%
Gender		
Male	51	61.4
Female	30	36.1
Prefer Not to Respond	2	2.4
Highest Level of Education		
Bachelor's Degree	46	55.4
Master's Degree	36	43.4
Specialist's Degree	1	1.2
Doctoral Degree	0	0
Age		
22-29	22	27
30-39	12	14
40-49	20	24
50-59	19	23
60-64	9	11
65 or Older	1	1.2
Years of Teaching Experience		
0-5	24	28.9
6-10	10	12.0
11-15	6	7.2
16-20	11	13.3
21-25	6	7.2
26-30	6	7.2
More than 30	27	24.1

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Respondent Demographics

Summary of Respondents' Demographic Characteristics continued

	f	%
Campus Location Designation		
Rural (population < 5,000)	65	78.3
Small Urban (population 5,001 – 20,000)	15	18.1
Urban (population < 20,000)	3	3.6
Number of Agricultural Education Teachers in Department		
1 Teacher	76	91.6
2 Teachers	5	6.0
3 Teachers	1	1.2
4 Teachers	1	1.2
Teacher Training Program		
Traditional Land Grant	65	79.3
Traditional Regional State College or University	13	15.9
Traditional Private College or University	2	2.4
Non-traditional Teacher Accreditation Program	2	2.4
FFA District in which Program Resides		
North West	17	20.5
North Central	15	18.1
North East	13	15.7
South West	14	16.9
South Central	13	15.7
South East	11	13.3

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Findings - Importance

Importance of UAV Curricular Components as Perceived by Iowa SBAE Instructors

		NI	SI	MI	VI	EI
UAV Curricular Criteria	*n*	*f(%)*	*f(%)*	*f(%)*	*f(%)*	*f(%)*
Mapping or sensing operations	85	0(0)	4(4.3)	9(7.7)	**39(28.2)**	33(28.2
Identification of uses in agricultural settings	85	0(0)	1(0.9)	12(10.3	**43(36.8)**	29(24.8
Student operation in authentic settings	86	0(0)	1(0.9)	21(17.9)	**37(31.6)**	27(23.1
Manual flight control skills	86	0(0)	1(0.9)	23(19.7)	**43(36.8)**	19(16.2
Autonomous flight control skills	86	0(0)	5(4.3)	15(12.8)	**50(42.7)**	16(13.7
FAA regulations for UAVs	86	0(0)	6(5.1)	25(21.4)	**38(32.5)**	17(14.5
Flight dynamics operation considerations	86	1(0.9)	3(2.6)	25(21.4)	**48(41.0)**	9(7.7)
Identification of UAV flight dynamics	86	1(0.9)	3(2.6)	25(21.4)	**48(41.0)**	9(7.7)
Autonomous control component identification	85	1(0.9)	5(4.3)	24(20.5)	**46(39.3)**	9(7.7)
Parts and functions of a UAV	86	0(0)	7(6.0)	26(22.2)	**43(36.8)**	10(8.5)
Photography or videography	85	0(0)	10(8.5)	26(22.2)	**34(29.1)**	15(12.8
FAA drone licensed instructor	86	6(5.1)	16(13.7)	19(16.2)	**24(20.5)**	21(17.9
Manual control components of UAV	86	2(1.7)	10(8.5)	31(26.5)	**36(30.8)**	7(6.0)
Parts & principles of energy transfer in UAVs	86	2(1.7)	15(12.8)	**42(35.9)**	22(18.8)	5(4.3)

Note: 1=Not at all important 5=Extremely important. Mode indicated in bold.

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Findings – Capacity to Teach

Capacity to Teach UAV Curricular Components as Perceived by Iowa SBAE Instructors

UAV Curricular Criteria	*n*	NE *f(%)*	SE *f(%)*	ME *f(%)*	VE *f(%)*	EE *f(%)*
Identification of uses in agricultural settings	83	13(11.1)	15(12.8)	**30(25.6)**	20(17.1)	5(4.3)
Student operation in authentic settings	83	19(16.2)	18(15.4)	**24(20.5)**	18(15.4)	4(3.4)
Photography or videography	82	16(13.7)	**30(25.6)**	26(22.2)	9(7.7)	1(0.9)
Manual flight control skills	83	24(20.5)	**28(23.9)**	24(20.5)	4(3.4)	3(2.6)
Mapping or sensing operations	82	23(19.7)	23(19.7)	**25(21.4)**	8(6.8)	3(2.6)
FAA regulations for UAVs	83	23(19.7)	23(19.7)	**29(24.8)**	7(6.0)	2(0.9)
Flight dynamics operation considerations	83	24(20.5)	**29(24.8)**	19(16.2)	7(6.0)	4(3.4)
Parts and functions of a UAV	83	24(20.5)	25(21.4)	**27(23.1)**	4(3.4)	3(2.6)
Autonomous control component identification	83	26(22.2)	**28(23.9)**	17(14.5)	8(6.8)	4(3.4)
Identification of UAV flight dynamics	83	23(19.7)	**27(23.1)**	**27(23.1)**	4(3.4)	2(1.7)
UAV components of manual control	83	24(20.5)	**28(23.9)**	24(20.5)	4(3.4)	3(2.6)
Autonomous flight control skills	83	27(23.1)	**29(24.8)**	17(14.5)	6(5.1	4(3.4)
Parts & principles of energy transfer in UAVs	83	27(23.1)	**29(24.8)**	20(17.1)	5(4.3)	2(1.7)
FAA drone licensed instructor	82	**43(36.8)**	19(16.2)	15(12.8)	3(2.6)	2(1.7)

Note: 1=Not at all effective 5=Extremely effective. Mode indicated in bold.

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Findings - WMDS

UAV (Drone) Teaching Competencies Ranked by Mean Weighted Discrepancy Score as Perceived by Iowa SBAE Instructors

UAV Curricular Criteria/Teacher Competency	*n*	Importance[a] Rank	Capacity[b] Rank	Importance[a] Mean	Capacity[b] Mean	WMDS
Mapping or sensing operations	67	1	5	4.19	2.33	7.83
FAA regulations	86	6	6	3.77	2.28	7.23
Manual flight control skills	66	4	4	3.93	2.36	6.69
Autonomous flight control skills	82	5	12	3.9	2.17	6.69
Dynamics of UAV flight	82	7	10	3.71	2.22	6.50
FAA drone licensed instructors	66	12	14	3.44	1.80	5.71
Student use in authentic agricultural settings	82	2	2	4.05	2.64	5.66
Uses in agriculture	81	3	1	4.03	2.84	5.58
Components of autonomous control	82	9	9	3.67	2.23	5.52
Operation considerations for flight	82	8	7	3.71	2.25	5.44
Identification of parts and functions	82	10	8	3.65	2.24	5.18
Photography or videography	80	11	3	3.64	2.38	4.52
Identification of components for manual control	65	13	11	3.42	2.20	3.89
Principles of energy transfer	82	14	13	3.15	2.11	3.42

Note: Weighted Mean Discrepancy Score (Borich, 1980) = (Importance Score – Ability Score) * Importance Mean
[a]Importance scale: 1=Not at all important, 2=Slightly important, 3=Moderately important, 4=Very important, 5=Extremely important. [b]Capacity to Teach Scale = 1=Not effective at all, 2=Slightly effective, 3=Moderately effective, 4=Very effective, 5=Extremely effective.

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Additional Findings

Summary of Respondents' UAV (Drone) Related Information

Currently Teaches Ag Mechanics Coursework	*f*	%
Yes	56	67.5
No	27	32.5
Holds an FAA AUV (Drone) License	*f*	%
Yes	3	3.6
No	80	96.4
Curriculum Includes UAVs	*f*	%
Yes	18	21.7
No	65	78.3
Type of Drone Used in Curriculum (*n*=18)	*f*	%
Fixed Wing	0	0
Quadcopter	14	82.3
Hexacopter	1	6.9
Octocopter	0	0
Other	2	11.8
Supplementary Data Collection Equipment Used (*n*=18)	*f*	%
Stationary Photography	14	77.8
Video	13	72.2
Mapping	6	33.3
Thermal Imaging	0	0
Annual UAV Capital Purchase Budget (*n*=10)		
Minimum	0	
Maximum	$2500	
Mean	$775	
Std. Dev.	$837.08	

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Additional Findings

Interest in Teacher Training (*n*=82)	Yes		No	
	f	%	*f*	%
UAV FAA Licensure	60	73.2	22	26
UAV Curriculum Development/Integration	71	86.6	11	13
UAV Grant Writing Assistance	53	64.6	29	35
UAV Operation Skill Development	71	86.6	11	13
UAV Maintenance Skill Development	67	81.7	15	18
UAV Supplementary Data Collection	73	89.0	9	11

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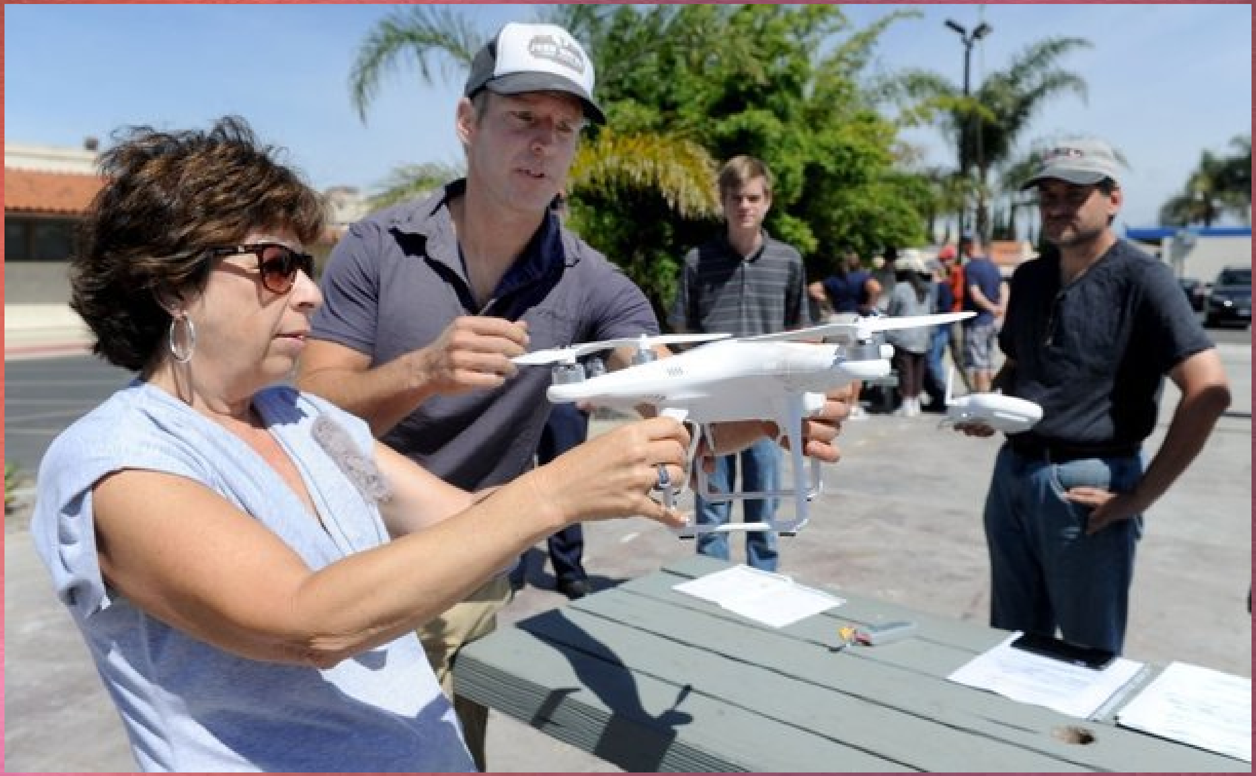
Conclusions

- Secondary agricultural education teachers need high quality training opportunities to increase self-efficacy regarding UAV integration into their SBAE curriculum.



Retrieved from: http://archive.vcstar.com/news/education/schoolwatch/educators-soar-through-drone-boot-camp-ep-1220869084-351099371.html

Conclusions

- Borich's (1980) WMDS "enables researchers…to purposefully prioritize [training] competencies so participants can receive training in the most needed area first…" (McKim, 2015)

- We found, 11 of 14 competencies WMDS > 5.00 (Range 3.42-7.83)

- In comparison, Iowa Ag Mechanics Competencies Study, (Shultz *et al.*, 2014)
  - Only 1 of 54 competencies WMDS > 5.00
  - WMDS ranged from 0.49 – 5.71

- Arizona Ag Mechanics Competencies Study (Lester, 2012)
  - 0 of 43 competencies > 5.00
  - Ranged from -0.97 – 3.51

- Iowa Ag Teachers' UAV Training Needs are high!

Recommendations for Training

- Training should align with Bandura (1989) and include:
  - UAV skill development (Mastery experiences)
  - Team-based activities using skilled peer leaders (Vicarious experiences)
  - Feedback from experienced faculty facilitators (Social persuasion)
  - Skills-based group performance (Physiological and emotional arousal)

- Utilize WMDS findings as beginning topics for training programs

UAV Curricular Criteria	WMDS
Mapping or sensing operations	7.83
FAA regulations	7.23
Manual flight control skills	6.69
Autonomous flight control skills	6.69
Dynamics of UAV flight	6.50

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Recommendations for Future Research

- Expand study to additional states (7-12 Ag Ed)
- Expand study to (7-12 STEM Teachers in Iowa)
- Expand to Community College Teachers
- Study training effectiveness
- Study student impact of training

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