George Mason University
College of Education and Human Development
Mathematics Education Leadership

MATH 612.6M5 – Probability and Statistics for K-8 Teachers
3 Credits, Spring 2020
Tuesdays 4:30 – 7:10 Synchronous Online

Faculty

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Prerequisites/Corequisites

Admission to the Mathematics Education Leadership Master's Degree Program or instructor permission. Enrollment limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree or Senior Plus. Enrollment is limited to Graduate, Non-Degree or Undergraduate level students. Students in a Non-Degree Undergraduate degree may not enroll.

University Catalog Course Description

An introduction to probability, descriptive statistics, and data analysis. Topics studied will include the exploration of randomness, data representation, modeling. Descriptive statistics will include measures of central tendency, dispersion, distributions, and regression. The analysis of experiments requiring hypothesizing, experimental design and data gathering will also be discussed.

Course Overview

This course is for future K-8 mathematics teacher specialists will cover the Virginia SOL strands in probability and statistics, especially those in grades 5-8. Special attention will be given to interpreting and assessing students' work and learning.

Course Delivery Method

This course will be delivered online (76% or more) using a synchronous format via Blackboard Learning Management system (LMS) housed in the MyMason portal. You will log in to the Blackboard (Bb) course site using your Mason email name (everything before @masonlive.gmu.edu) and email password. The course site will be available on [Day and/or Time].

Under no circumstances, may candidates/students participate in online class sessions (either by phone or Internet) while operating motor vehicles. Further, as expected in a face-to-face class meeting, such online participation requires undivided attention to course content and communication.

Technical Requirements

To participate in this course, students will need to satisfy the following technical requirements:

- High-speed Internet access with standard up-to-date browsers. To get a list of Blackboard's supported browsers see:

https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support#supported-browsers

To get a list of supported operation systems on different devices see:
https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support#tested-devices-and-operating-systems

- Students must maintain consistent and reliable access to their GMU email and Blackboard, as these are the official methods of communication for this course.
- Students will need a headset microphone for use with the Blackboard Collaborate web conferencing tool.
- Students may be asked to create logins and passwords on supplemental websites and/or to download trial software to their computer or tablet as part of course requirements.

Expectations

- Course Week: Our course week will begin on the day that our synchronous meetings take place as indicated on the Schedule of Classes.
- Log-in Frequency:

Students must actively check the course Blackboard site and their GMU email for communications from the instructor, class discussions, and/or access to course materials at least 2 times per week. In addition, students must log-in for all scheduled online synchronous meetings.

- Participation:

Students are expected to actively engage in all course activities throughout the semester, which includes viewing all course materials, completing course activities and assignments, and participating in course discussions and group interactions.

- Technical Competence:

Students are expected to demonstrate competence in the use of all course technology. Students who are struggling with technical components of the course are expected to seek assistance from the instructor and/or College or University technical services.

- Technical Issues:

Students should anticipate some technical difficulties during the semester and should, therefore, budget their time accordingly. Late work will not be accepted based on individual technical issues.

- Workload:

Please be aware that this course is **not** self-paced. Students are expected to meet *specific deadlines* and *due dates* listed in the **Class Schedule** section of this syllabus. It is the student's responsibility to keep track of the weekly course schedule of topics, readings, activities and assignments due.

- Instructor Support:

Students may schedule a one-on-one meeting to discuss course requirements, content or other course-related issues. Those unable to come to a Mason campus can meet with the instructor via telephone or web conference. Students should email the instructor to schedule a one-on-one session, including their preferred meeting method and suggested dates/times.

- Netiquette:

The course environment is a collaborative space. Experience shows that even an innocent remark typed in the online environment can be misconstrued. Students must always re-read their responses carefully before posting them, so as others do not consider them as personal offenses. *Be positive in your approach with others and diplomatic in selecting your words*. Remember that you are not competing with classmates, but sharing information and learning from others. All faculty are similarly expected to be respectful in all communications.

- Accommodations:

Online learners who require effective accommodations to insure accessibility must be registered with George Mason University Disability Services.

Learner Outcomes or Objectives

This course is designed to enable students to do the following:

This course is designed to enable students to do the following:

1. Develop a comprehensive understanding of probability and statistics reasoning, representation and data collection.
2. Examine in depth probability and statistics content appropriate for K-8 mathematics teachers, including the use of technology to study probability and statistics and historical connections to probability and statistics.
3. Explore the fundamentals of data collection, data analysis, probability, statistics, and relationships.
4. Examine probability and statistics Habits of Mind, in order to assess their own progress throughout the course and to discover these models' pedagogical implications on classroom instruction.

Professional Standards (National Council of Teachers of Mathematics)

Upon completion of this course, students will have met the following professional standards:

To be prepared to support the development of student mathematical proficiency, all elementary mathematics specialists should know the following topics related to statistics and probability with

their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

C.4.1 Statistical variability and its sources and the role of randomness in statistical inference
C.4.2 Construction and interpretation of graphical displays of univariate and bivariate data distributions (e.g., box plots and histograms), summary measures (mean, median, mode, interquartile range, and mean absolute deviation) and comparison of distributions of univariate data, and exploration of categorical (discrete) and measurement (continuous) data
C.4.3 Empirical and theoretical probability for both simple and compound events
C.4.4 Random (chance) phenomena and simulations
C.4.5 Historical development and perspectives of statistics and probability including contributions of significant figures and diverse cultures

Standard 2: Mathematical Practices (NCTM NCATE Mathematics Content for Elementary Mathematics Specialist *Addendum to the NCTM NCATE Standards 2012)*

In their role as teacher, lead teacher, and/or coach/mentor, elementary mathematics specialist candidates:

3a) Apply knowledge of curriculum standards for elementary mathematics and their relationship to student learning within and across mathematical domains in teaching elementary students and coaching/mentoring elementary classroom teachers.
3c) Plan and assist others in planning lessons and units that incorporate a variety of strategies, differentiated instruction for diverse populations, and mathematics-specific instructional technologies in building all students' conceptual understanding and procedural proficiency.
3e) Implement and promote techniques related to student engagement and communication including selecting high quality tasks, guiding mathematical discussions, identifying key mathematical ideas, identifying and addressing student misconceptions, and employing a range of questioning strategies.
5b) Engage students and coach/mentor teachers in using developmentally appropriate mathematical activities and investigations that require active engagement and include mathematics-specific technology in building new knowledge.

Required Texts

Russell, S. J., Shifter, D., & Bastable, V. (2018). *Statistics: Modeling with data casebook.* Reston, VA: National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (2014). *Principles to actions: ensuring mathematical success for all*. Reston, VA: National Council of Teachers of Mathematics.

Recommended Texts

Van de Walle, J., Karp, K, & Bay-Williams, J. (2018). *Elementary and middle school mathematics: Teaching developmentally* (10th edition). Boston, MA: Pearson Education.

American Psychological Association (2010*). Publication Manual of the American Psychological Association* (7th edition). Washington, DC: American Psychological Association.

Course Performance Evaluation

Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard, Tk20, hard copy). Assignments submitted late without prior approval from the instructor will not be graded for full credit.

All assignments require APA formatting. See recommended texts for resources on APA formatting. Specifically, the following aspects of APA formatting should be addressed in any submission:

- 12 point, Times New Roman font
- Double spaced
- Page headers/Running head
- Cover page with title, author's name and professional affiliation
- References
- Headings
- Citations
- Clearly organized, grammatically correct, coherent and complete
- Professional language (i.e. no jargon)

- **Assignments and/or Examinations**

A. Reflections (50%) – Performance Based Assessment

NCATE/NCTM Indicator 1a (C.2.1 - C. 2.5), 2a, 2b, 2c, 2f

Student will reflect on four rich mathematical tasks and submit a reflection for each. Additionally, students will explore a historical figure and write a reflection on the historical contribution.

B. Individual Content Assessments (20%)

Students will complete various individual content assessments that will assess their individual understanding of K-8 probability and statistics content.

C. Mathematics in STEM Rich Tasks (20%)

Explore a probability and statistics rich task using math specific technology (ie: virtual graphing software, Geogebra, etc. NOT Smartboards, iPads, etc.) and science or engineering. Prepare a short presentation for teachers that explains how the task, technology, and science or engineering can be used for probability and statistics in multiple grade levels. The presentation should be interactive and engage teachers in using the technology to explore a task.

D. Participation (10%)

Students are expected to participate actively. This requires students to consider probability and statistics using different strategies and a variety of manipulatives and resources. During math work time, students should be developing algorithms for the entire work time, or discussing and sharing algorithms with each other. During math-talk and discussion times,

students should be actively engaged by voicing their thoughts and connecting to topics presented during the discussion.

- **Grading**

A 93%-100%	B+ 87%-89%	C 70%-79%
A- 90%-92%	B 80%-86%	F Below 70%

- **For Master's Degrees**:
  Candidates must have a minimum GPA of 3.00 in coursework presented on the degree application, which may include no more than 6 credits of C. (Grades of C+, C-, or D do not apply to graduate courses. The GPA calculation excludes all transfer courses and Mason non-degree studies credits not formally approved for the degree).

- **For Endorsement Requirements**
  Candidates must have a grade of B or higher for all licensure coursework (endorsement coursework).

Professional Dispositions

See https://cehd.gmu.edu/students/polices-procedures/

Class Schedule

Date	Assignment Due
January 28 **Introduction to Probability**	Welcome Announcement Access Blackboard Collaborate
February 4 **Probability: Empirical and Theoretical**	**READINGS** PTA: Effective Teaching and Learning (p.7 - 12) STAT: Introduction (p. 1) **ASSIGNMENTS** PBA #3 Due
February 11 **Probability as a tool for statistics**	**READINGS** PTA: Establish Mathematics Goals to Focus Learning (p.12) STAT: Probability as a tool for statistics (p. 89-91) Reading on Bboard: Determining Probabilities by Examining Underlying Structure from Rich & Engaging Mathematical Tasks Grades 5-9
February 18	**READINGS**

Problem solving using Categorical Data **Asynchronous**	PTA: Implement Tasks That Promote Reasoning and Problem Solving (p. 17) STAT: Displaying distributions of categorical data (p. 13 – 17) STAT: Numerical summaries of categorical data (p. 17 – 19) **ASSIGNMENTS** PBA #4 Due
February 25 **Connecting representations of quantitative data**	**READINGS** PTA: Use and Connect Mathematical Representations (p. 24) STAT: Displaying distributions of quantitative data (p. 19 – 21) STAT: Assessing Statistical Understanding (p. 100 – 104) **ASSIGNMENTS** Individual Content Assessment #1 Due
March 3 **Meaningful discourse using math terms for center**	**READINGS** PTA: Facilitate Meaningful Mathematical Discourse (p. 29) STAT: Measuring the center of a distribution (p. 21 – 24) STAT: Measuring the amount of variability in a distribution (p. 24 – 28) Reading on Bboard: Developing a Meaningful Understanding of the Mean from Rich & Engaging Mathematical Tasks Grades 5-9
March 10 **Asynchronous**	GMU Spring Break – Work Groups Meet
March 17 **What questions do your data answer?**	**READINGS** PTA: Pose Purposeful Questions (p. 35) STAT: Grouping Data (p. 28 – 31) STAT: The shape of a distribution (p. 32) Reading on Bboard: Exploring Probability through an Evens-Odds Dice Game from Rich & Engaging Mathematical Tasks Grades 5-9
March 24 **Understanding the Outliers**	**READINGS** PTA: Build Procedural Fluency from Conceptual Understanding (p. 42) STAT: An alternative grouping strategy (p. 32 – 35) STAT: Outliers (p. 36 – 41) Reading on Bboard: Rethinking Fair Games from Rich & Engaging Mathematical Tasks Grades 5-9 **ASSIGNMENTS** Individual Content Assessment #3 Due

March 31 **STEM in Statistics**	**ASSIGNMENTS** STEM Integration Project Due Presentation (5 min) on your STEM Integration Project
April 7 **Productive struggle in statistics**	**READINGS** PTA: Support Productive Struggle in Learning Mathematics (p. 48) STAT: Comparing Distributions: Big Idea 2 (p.42 – 50) **ASSIGNMENTS** PBA #2 Due
April 14 **Using student work to ask questions about data**	**READINGS** PTA: Elicit and Use Evidence of Student Thinking (p. 53) STAT: Associations between Two Variables: Big Idea 3 (p.51-65) **ASSIGNMENTS** PBA #1 Due
April 21 **Samples and Populations**	**READINGS** STAT: Samples and Populations: Big Idea 4 (p.67 – 78) Reading on Bboard: Capture and Recapture Your Students' Interest in Statistics from Rich & Engaging Mathematical Tasks Grades 5-9 **ASSIGNMENTS**
April 28 **Math leadership in probability and statistics**	**READINGS** STAT: Connections: Looking Back and Ahead in Learning (p. 81 – 92) **ASSIGNMENTS** PBA #5 Historical Reflection

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.

Core Values Commitment

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: http://cehd.gmu.edu/values/.

GMU Policies and Resources for Students

Policies

- Students must adhere to the guidelines of the Mason Honor Code (see https://catalog.gmu.edu/policies/honor-code-system/).
- Students must follow the university policy for Responsible Use of Computing (see https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/).
- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.
- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see https://ds.gmu.edu/).
- Students must silence all sound emitting devices during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to Tk20 should be directed to tk20help@gmu.edu or https://cehd.gmu.edu/aero/tk20. Questions or concerns regarding use of Blackboard should be directed to https://its.gmu.edu/knowledge-base/blackboard-instructional-technology-support-for-students/.
- For information on student support resources on campus, see https://ctfe.gmu.edu/teaching/student-support-resources-on-campus

Notice of mandatory reporting of sexual assault, interpersonal violence, and stalking:

As a faculty member, I am designated as a "Responsible Employee," and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-380-1434 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek

assistance from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu.

For additional information on the College of Education and Human Development, please visit our website https://cehd.gmu.edu/students/ .

Prob/Stat Rich Task Reflection

Course Performance Based Assessment

Reflection Logs 1-4 Rubric

Level/Criteria	4	3	2	1
	Exceeds Expectations	**Meets Expectations**	**Developing**	**Does Not Meet Expectations**
BUILDING CONCEPTUAL AND PROCEDURAL UNDERSTANDING **NCTM Element 1.a** Demonstrate and apply knowledge of major mathematics concepts, algorithms, procedures, applications in varied contexts and connections.	The candidate includes all of the following elements: ● Application of conceptual and procedural knowledge in identifying solutions in the problem set ● Explanation of the development of conceptual to procedural knowledge ● Discussion of new knowledge gained and the connections to past knowledge and experiences	The candidate includes two of the following elements: ● Application of conceptual and procedural knowledge in identifying solutions in the problem set ● Explanation of the development of conceptual to procedural knowledge ● Discussion of new knowledge gained and the connections to past knowledge and experiences	The candidate includes one of the following elements: ● Application of conceptual and procedural knowledge in identifying solutions in the problem set ● Explanation of the development of conceptual to procedural knowledge ● Discussion of new knowledge gained and the connections to past knowledge and experiences	The candidate does not include any of following elements: ● Application of conceptual and procedural knowledge in identifying solutions in the problem set ● Explanation of the development of conceptual to procedural knowledge ● Discussion of new knowledge gained and the connections to past knowledge and experiences
PROBLEM SOLVING **NCTM Element 2.a** Use problem solving to develop conceptual understanding, make a sense of a wide variety of problems and persevere in solving them, apply and adapt a variety of strategies	The candidate includes all of the following elements: ● Describes the use of problem solving within the problem set	The candidate includes two of the following elements: ● Use of problem solving within the problem set to formulate generalizations	The candidate includes one of the following elements: ● Use of problem solving within the problem set to formulate generalizations	The candidate does not include any of following elements: ● Use of problem solving within the problem set to

in solving problems confronted within the field of mathematics and other contexts, and formulate and test conjectures in order to frame generalizations.	to formulate generalizations ● Explains how to make sense of the problems in the problem set ● Apply a variety of strategies and representations to the problem set	● Make sense of the problems in the problem set ● Apply a variety of strategies and representations to the problem set	● Make sense of the problems in the problem set ● Apply a variety of strategies and representations to the problem set	formulate generalizations ● Make sense of the problems in the problem set ● Apply a variety of strategies and representations to the problem set
REPRESENTATIONS **NCTM Element 2.b** Reason abstractly, reflectively, and quantitatively with attention to units, constructing viable arguments and proofs, and critiquing the reasoning of others; represent and model generalizations using mathematics; recognize structure and express regularity in patterns of mathematical reasoning; use multiple representations to model and describe mathematics; and utilize appropriate mathematical vocabulary and symbols to communicate mathematical ideas to others.	The candidate includes all of the following elements: ● Describes how multiple representations were used to model the problem set ● Discusses how the representations support the creation of generalizations ● Uses appropriate mathematical vocabulary and symbols	The candidate includes two of the following elements: ● Describes how multiple representations were used to model the problem set ● Discusses how the representations support the creation of generalizations ● Uses appropriate mathematical vocabulary and symbols	The candidate includes one of the following elements: ● Describes how multiple representations were used to model the problem set ● Discusses how the representations support the creation of generalizations ● Uses appropriate mathematical vocabulary and symbols	The candidate does not include any of following elements: ● Describes how multiple representations were used to model the problem set ● Discusses how the representations support the creation of generalizations ● Uses appropriate mathematical vocabulary and symbols
CONTEXT **NCTM Element 2.C** Formulate, represent, analyze, and interpret mathematical models derived from real-world contexts of mathematical problems.	The candidate includes all of the following elements: ● An example of a similar problem with a different context. ● An analysis of a similar problem (compare and contrast) ● An interpretation of the solution	The candidate includes two of the following elements: ● An example of a similar problem with a different context. ● An analysis of a similar problem (compare and contrast) ● An interpretation of the solution	The candidate includes one of the following elements: ● An example of a similar problem with a different context. ● An analysis of a similar problem (compare and contrast) ● An interpretation of the solution	The candidate does not include any of following elements: ● An example of a similar problem with a different context. ● An analysis of a similar problem (compare and contrast) ● An interpretation of the solution
NCTM PROCESS STANDARDS	The candidate includes a	The candidate includes a	The candidate includes a	The candidate includes a

NCTM Element 2.F Use and assist teachers in using resources from professional mathematics education organizations such as teacher/leader discussion groups, teacher networks, and print, digital, and virtual resources/ collections	reflection on the process standards that includes a description of how each of the five NCTM Process Standards impact the mathematical understanding. The reflection includes specific instances where the candidate assisted teachers using all of the following elements: ● Teacher/Leader discussion groups ● Teacher networks ● Print, digital, and virtual resources/ collections	reflection on the process standards that includes a description of how four of the five NCTM Process Standards impact the mathematical understanding. The reflection includes specific instances where the candidate assisted teachers using two of the following elements: ● Teacher/Leader discussion groups ● Teacher networks ● Print, digital, and virtual resources/ collections	reflection on the process standards that includes a description of how three of the five NCTM Process Standards impact the mathematical understanding. The reflection includes specific instances where the candidate assisted teachers using one of the following elements: ● Teacher/Leader discussion groups ● Teacher networks ● Print, digital, and virtual resources/ collections	reflection on the process standards that includes a description of how one or two NCTM Process Standards impact the mathematical understanding. The reflection does not include any specific instances where the candidate assisted teachers using all of the following elements: ● Teacher/Leader discussion groups ● Teacher networks ● Print, digital, and virtual resources/ collections
PAPER ORGANIZATION	The paper organization includes all of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style. ● The paper meets APA	The report organization includes five of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style.	The report organization includes four of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style.	The report organization includes three or fewer of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style.

	formatting guidelines.	● The paper meets APA formatting guidelines.	● The paper meets APA formatting guidelines.	● The paper meets APA formatting guidelines.

Reflection Log 5 rubric

The final reflection log will involve researching a major mathematical historical development and the contributions of a historically significant figure. We will discuss many of these developments and figures during the math talk all throughout the semester. However, this discussion will be brief. Once you find a topic that interests you, you should research it further. The following reflection should be about 2 pages in length and will be evaluated using the following criteria.

Levels/Criteria	**4**	**3**	**2**	**1**
	Exceeds Expectations	**Meets Expectations**	**Developing**	**Does Not Meet Expectations**
NCTM Indicator C.1.5 Historical development of probability and statistics.	Essay describes the historical development of probability and statistics in depth and provides specific examples.	Essay describes the historical development of probability and statistics and provides specific examples.	Essay describes the historical development of probability and statistics and provides an example.	Essay includes incomplete description of historical development of probability and statistics.
NCTM Indicator C.1.5 Historical perspectives of probability and statistics.	Essay describes the historical perspectives of probability and statistics in depth and provides specific examples.	Essay describes the historical perspectives of probability and statistics and provides specific examples.	Essay describes the historical perspectives of probability and statistics and provides an example.	Essay includes incomplete description of historical perspectives of probability and statistics.
NCTM Indicator C.1.5 Contributions of historically significant figures and diverse cultures.	Essay describes contributions of historically significant figures and diverse cultures in depth and provides specific examples.	Essay describes contributions of historically significant figures and diverse cultures and provides specific examples.	Essay describes contributions of historically significant figures and diverse cultures and provides an example.	Essay includes incomplete description of historically significant figures and diverse cultures.
Paper Organization	The paper organization includes all of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically	The report organization includes five of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically	The report organization includes four of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized, grammatically	The report organization includes three or fewer of the following: ● A cover page with title, author's name, and professional affiliation. ● The paper is well-organized,

	correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style. The paper meets APA formatting guidelines.	correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style. The paper meets APA formatting guidelines.	correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style. The paper meets APA formatting guidelines.	grammatically correct, coherent, and complete. ● The paper has distinctive focus and voice. ● The paper uses professional language (i.e., no jargon). ● The paper is presented in an accessible style. The paper meets APA formatting guidelines.