

**Health Services
Administration**

University of Wyoming

**PHCY 5043-40
Empirical Analysis for Health
Services Administration**

Fall 2021

September 19- November 7



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Empirical Analysis for Health Services Administration
Fall 2021

Course Description: This course builds on a knowledge of research methods and statistical analysis to provide an overview of how research methods and data analysis can be used by researchers and clinicians to draw conclusions about health services, clinical technologies and programs, and policy analysis. The purpose of the course is to equip students with an understanding of research and policy debates related to economic, political, and administrative aspects of health services.

Prerequisites:

PHCY 5041 Health Services Administration Research Methods

PHCY 5042 Statistics for Health Services Administration

Course Objectives:

Upon successful completion of this course, the student will be able to:

- Evaluate the scientific validity and reliability of a published research article.
- Evaluate the title of a research article.
- Assess the accuracy and completeness of a research article's abstract.
- Determine whether the introduction provides a clear explanation of the nature and scope of the problem being investigated.
- Determine whether the objective of the study has been clearly stated, including the intended outcomes of the research.
- Evaluate the design of the study to determine whether the methods used will result in data that can be analyzed in order to support study objectives.
- Determine whether the study design is described in a clear and detailed way that will allow replication of the research by subsequent investigators.
- Evaluate the data source(s) to determine if it is appropriate for answering the study's research question(s).
- Determine if the study population is adequately described.
- Evaluate internal and external factors may introduce bias in the investigation.
- Determine whether the statistical tests used are appropriate, including potential errors in statistical analysis that may lead to invalid results and conclusions.
- Evaluate figures, tables, and charts to determine whether the results presented in these visual representations facilitate an understanding of the study and the data evaluated.
- Determine whether results have been appropriately presented and explained, including limitations of the study.
- Examine whether the discussion and conclusion are consistent with the study objectives and are justified by the results.
- Determine whether the research fits into the context of the conclusion.

- Evaluate the relationship between the analysis of study data and the conclusions of the researcher.
- Use the PICOS framework to determine if comparative studies have limited risk of bias.

STUDENT LEARNING OUTCOMES AND GOALS:

Upon successful completion of this course, the student will be able to:

- Evaluate the scientific validity and reliability of a published research article.
- Evaluate the title of a research article.
- Assess the accuracy and completeness of a research article’s abstract.
- Determine whether the introduction provides a clear explanation of the nature and scope of the problem being investigated.
- Determine whether the objective of the study has been clearly stated, including the intended outcomes of the research.
- Evaluate the design of the study to determine whether the methods used will result in data that can be analyzed in order to support study objectives.
- Determine whether the study design is described in a clear and detailed way that will allow replication of the research by subsequent investigators.

Course Goals:

This course is designed to critically evaluate evidence to answer questions related to medical care, health policy, and health services research. Study attributes of interest include: identifying relevant research questions, selecting appropriate research methods, use of appropriate statistical procedures, interpreting findings, and making conclusions based on the evidence presented. By the conclusion of this course it is expected that students will become critical consumers of health care evidence.

Place and Time of Class Sessions:

This course will be taught primarily in synchronous fashion. Virtual classroom sessions will be held live each week on Sunday afternoon/evening. Students will be responsible for completing course materials as their time permits, each week, during the 6 weeks of the course, with quizzes and exams being administered over sufficient time to accommodate busy professionals. Students are expected to actively participate in discussions and discussion board on a regular basis.

The course will adhere to the following schedule:

- Class 1: Course Orientation--The Importance of Scholarly Literature Evaluation
- Assigned Reading
- Class 2: Clinical Trials
- Class 3: Meta-Analyses
- Class 4: Observational Studies
- Class 5: Healthcare Leadership and Quality Improvement
- Class 6: Health Economics and Health Policy Analysis

Course Learning Resources:

- Required Readings
- Posted Video Lectures
- Journal Articles

Course Structure & Outline

This course will be conducted live using an online virtual classroom. The first course session will contain a discussion of the course structure and introductory material related to evaluating a research article. For the following next six weeks of the course, students will present research articles and led the discussion of these articles. Expect that more than 1 article will be discussed at each session.

INSTRUCTOR AVAILABILITY/ CONTACT INFORMATION:

Dan Malone

Office Hours: Online – by appointment

Email: dmalone4@uwyo.edu

CLASS WEBSITE:

The WyoCourses site is accessible from the University website via WyoWeb. Class lectures and slide sets will be posted or linked on this site. Assignments will also be posted there (both by the instructor and submitted by the student). The student is expected to utilize the site and accept changes from this syllabus as amended on the site.

COURSE PREREQUISITES, CO-REQUISITES, ENROLLMENT RESTRICTIONS:

This course is required for students in the Master of Science in Health Services Administration Health Institution Leadership track. Other track students may take the course as an elective. Enrollment in or completion of a degree in the health sciences administration program is strongly recommended.

COURSE PROCEDURES:

Instructional procedures consist of pre-recorded lecture, discussion, participation exercises plus assigned readings and projects. The distance education model of this course requires some adaptation by the students and instructor from the traditional classroom setting. **You may be recorded with your face and name.** This recording will be placed on a password protected site, but no guarantees are made on its security.

Different people have different learning styles. Lecture where the instructor talks and students listen is passive on the part of the student. Discussion requires active participation on the part of the learner. In this class, some topics are appropriate for lectures; some are appropriate for discussion; and some will be conducted through active participation such as analysis of case studies and or discussion boards.

GENERAL REQUIREMENTS AND EXPECTATIONS:

Students are encouraged to participate in live class sessions; active participation will also count towards your discussion board grade (see last page of syllabus for Guideline for Evaluating Participation).

In order for a discussion or dialogue to be successful, students must have read the assigned readings, watched any video recording and have completed some assignments **before** joining class. Assignments will be clearly indicated whether due before or after the live session. Whether a lecture or discussion, students should feel free to ask questions during class or on-line. If you have a question, other students may have the same question.

ATTENDANCE AND ABSENCE POLICIES:

Students must regularly attend online classes and/or participate in discussion board. Each student is expected to provide 1 “journal club” session lasting no more than 15 minutes. The purpose of the journal club is to provide a brief overview and critique of a published article. Each week up to 6 student presentations will be given. Papers for each week are provided below. Only 1 student may select each paper.

Students will earn 10 points for leading the journal club discussion for their selected paper. The remaining points (15) are earned by attending each class session, and participating in the discussion about the presented papers.

EXAM POLICY:

Inquiries regarding exams should be directed to the course coordinator, preferably prior to the exam, and always within a week following the assessment. At the discretion of the instructor, exams may be posted, with answers, to the course discussion board.

Two exams will be conducted. The mid-term exam will consist of a timed multiple choice and short answer online test. The final exam will be a take-home exam consisting of evaluating an assigned article. All exams (and quizzes) are independent activities. Contacting another student or sharing information about the quiz or exam is prohibited. This includes answering questions about the content, difficulty, format, or specific questions. All work is to be completely independent of any other person, including others not enrolled in the course.

MAKE-UP EXAM POLICY:

Students who miss an exam will receive a grade of zero on that missed assessment. Any student who misses quizzes and/or exams of a sufficient number that indicate the student has not completed enough coursework to achieve the objectives of the course will be given failing grade for the course.

QUIZZES

Each week students will be expected to complete an online quiz taken through the University of Wyoming’s Canvas course site. Quizzes will cover the papers and associated reading for the relevant week. Students will have 14 days after each session to complete the quiz for that week. Quizzes contribute 25% toward overall course grade. Each quiz is worth 10 points.

Inquiries regarding quizzes and exams should be directed to the course coordinator and within a week following the assessment. No grade appeals will be considered after this time has elapsed.

CLASSROOM BEHAVIOR POLICY:

At all times, treat your presence in the classroom and your enrollment in this course as you would any professional activity. Act professionally, arrive on time, pay attention, complete your work in a timely and professional manner, and treat all deadlines seriously. All of us will be respectful of each other. Spirited debate and disagreement are to be expected in any graduate level course and all views will be heard fully, but at all times we will behave civilly and with respect towards one another. Personal attacks, offensive language, name-calling, and dismissive gestures are not warranted in a learning atmosphere. This is a safe environment and as the instructor, I have the right to dismiss anyone from the classroom, study sessions, electronic forums, and other areas where disruptive behavior occurs – there is zero tolerance on this issue.

CLASSROOM STATEMENT ON DIVERSITY:

The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning. Diversity helps all of us gain a better understanding and perspective of the subjects we will be covering in the course.

DISABILITY SUPPORT:

The University of Wyoming is committed to providing equitable access to learning opportunities for all students. If you have a disability, including but not limited to physical, learning, sensory or psychological disabilities, and would like to request accommodations in this course due to your disability, please register with and provide documentation of your disability as soon as possible to Disability Support Services (DSS), Room 128 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. It is in the student's best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at: www.uwyo.edu/udss

ACADEMIC DISHONESTY POLICIES:

Academic dishonesty, discrimination, and harassment will not be tolerated in this class!

Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an "F" on an exam, an "F" on the class component exercise, and/or an "F" in the entire course. Academic dishonesty includes plagiarism, which means anything that represents someone else's ideas as your own without attribution. It is intellectual theft – stealing - and includes (but is not limited to) unapproved assistance on examinations, plagiarism (use of any amount of another person's writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person's academic dishonesty is also considered academic dishonesty and will be treated identically.

Such conduct is described within and will result in sanctions pursuant to the following School of Pharmacy and University policy and regulations:

University of Wyoming Code of Conduct

<http://www.uwyo.edu/dos/conduct/>

University of Wyoming Regulations

<http://www.uwyo.edu/generalcounsel/files/docs/UW%20Reg%20Updates%202016/UW%20Reg%206-802.pdf>

DUTY TO REPORT:

While this is a safe environment and I want you all to feel comfortable coming to me with issues you may be struggling with or concerns you may be having, please be aware that I have some reporting obligations that are part of my faculty requirements at UW.

For example, if you inform me of an issue of sexual harassment, sexual assault, or discrimination I will keep the information as private as I can, but I am required to bring it to the attention of the institution's Title IX Coordinator. If you would like to talk to those offices directly, you can contact Equal Opportunity Report and Response (Bureau of Mines Room 319, 766-5200, report-it@uwyo.edu, www.uwyo.edu/reportit). Additionally, you can also report incidents or complaints to the UW Police Department. You can also get support at the STOP Violence program

(stopviolence@uwyo.edu, www.uwyo.edu/stop, 766-3296) (or SAFE Project (www.safeproject.org, campus@safeproject.org, 766-3434, 24-Hour hotline: 745-3556).

Another common example is if you are struggling with an issue that may be traumatic or unusual stress. I will likely inform the Dean of Students Office or Counseling Center. If you would like to reach out directly to them for assistance, you can contact them using the info below or going to www.uwyo.edu/dos/uwyocares.

Finally, know that if, for some reason, our interaction involves a disruptive behavior or potential violation of policy, I must inform the Dean of Students, even when you and I may have reached an informal resolution to the incident. The purpose of this is to keep the Dean apprised of any behaviors (by students or faculty) and what was done to resolve them.

SUBSTANTIVE CHANGES TO THE SYLLABUS:

All deadlines, requirements, and course structure are subject to change if deemed necessary by the instructor. Students will be notified verbally in class or on our WyoCourses announcement page and/or via email of these changes.

STUDENT RESOURCES:

- DISABILITY SUPPORT SERVICES: udss@uwyo.edu, 766-3073, 128 Knight Hall, www.uwyo.edu/udss
- COUNSELING CENTER: uccstaff@uwyo.edu, 766-2187, 766-8989, 341 Knight Hall, www.uwyo.edu/ucc
- ACADEMIC AFFAIRS: 766-4286, 312 Old Main, www.uwyo.edu/acadaffairs
- DEAN OF STUDENTS OFFICE: dos@uwyo.edu, 766-3296, 128 Knight Hall, www.uwyo.edu/dos UW
- POLICE DEPARTMENT: uwpd@uwyo.edu, 766-5179, 1426 E Flint St, www.uwyo.edu/uwpd
- STUDENT CODE OF CONDUCT WEBSITE: www.uwyo.edu/dos/conduct

"If you have a physical, learning, sensory or psychological disability and require accommodations, please let me know as soon as possible. You will need to register with, and possibly provide documentation of your disability to Disability Support Services (DSS), room 109 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. Visit their website for more information: www.uwyo.edu/udss."

COVID-19 Policies:

During this pandemic, you must abide by all UW policies and public health rules put forward by the City of Laramie (or by Natrona County if at UW-Casper), the University of Wyoming and the State of Wyoming to promote the health and well-being of fellow students and your own personal self-care. The current policy is provided for review at: <https://www.uwyo.edu/alerts/campus-return/index.html>

As with other disruptive behaviors, we have the right to dismiss you from the classroom (Zoom and physical), or other class activities if you fail to abide by these COVID-19 policies. These behaviors will be referred to the Dean of Students Office using the UWYO Cares Reporting Form for Student Code of Conduct processes (https://cm.maxient.com/reportingform.php?UnivofWyoming&layout_id=5).

Syllabus Changes:

I will alert you to any possible course format changes in response to UW decisions about community safety during the semester.

HyFlex, Zoom, and WyoCourses expectations:

As with all UW coursework, this course will be educational and useful to you. I will respond to questions, concerns, and feedback in a timely manner.

Your responsibilities:

- Give and receive feedback from me and your classmates respectfully and constructively in all interactions. This includes in live chats, on WyoCourses boards, and within physical classroom spaces.
- Actively engage in civil discourse in a respectful manner. Use professional language in all course related forums.
- Communicate professionally. Whenever you send class-related email or messages, please include a clear, specific subject line and use the body of the email or message to explain the purpose for the email and any attached materials. Conduct yourself professionally.
- Meet assignment deadlines. We expect that you're interacting with course material multiple times during the week.
- Ask for help when you need it. For academic assistance for this course please contact me for available resources. For Dean of Students assistance please see: <https://www.uwyo.edu/dos/student-resources/covid-19-student-resources.html>
- Please let us know if you notice another student who needs help in our (anonymous) WyoCares referral option (<https://www.uwyo.edu/dos/students-concern/index.html>).

Information Technology (IT): If you have any IT related challenges, please contact the UWIT Service Center: <https://uwyo.teamdynamix.com/TDClient/1940/Portal/Requests/ServiceDet?ID=8890>

COVID-19 Policies – during this pandemic, you must abide by all UW policies and public health rules put forward by the City of Laramie (or by Natrona County if at UW-Casper), the University of Wyoming and the State of Wyoming to promote the health and well-being of fellow students and your own personal self-care. The current policy is provided for review at: <https://www.uwyo.edu/alerts/campus-return/index.html> ([Links to an external site.](#))

As with other disruptive behaviors, we have the right to dismiss you from the classroom (Zoom and physical), or other class activities if you fail to abide by these COVID-19 policies. These behaviors will be referred to the Dean of Students Office using the UWYO Cares Reporting Form for Student Code of Conduct processes (https://cm.maxient.com/reportingform.php?UnivofWyoming&layout_id=5 ([Links to an external site.](#))).

Information Technology (IT): If you have any IT related challenges, please contact the UWIT Service Center: <https://uwyo.teamdynamix.com/TDClient/1940/Portal/Requests/ServiceDet?ID=8890> ([Links to an external site.](#))

GRADES

A:	90.0 – 100.0
B:	80.0 – 89.9
C:	70.0 – 79.9
D:	60.0 – 69.9
F:	<60.0

Graduate students, including those enrolled in the Master of Science in Health Services Administration, must maintain a 3.00 GPA (B or better). Note: there is no rounding of grades – an 89.9 is not 90.

Evaluation Techniques:

Class participation	25%
Weekly quizzes	25%
Exams (2 – midterm and final)	50%

COURSE SCHEDULE:**Readings by Week:****Week 1 – Course introduction**

Krousel-Wood et al. Clinician's guide to statistics for medical practice and research: part I. *The Ochsner Journal* 2006; 6:68-83.

Krousel-Wood et al. Clinician's guide to statistics for medical practice and research: part II. *The Ochsner Journal* 2007; 7:3-7.

Week 2 – Clinical Trials

*Guyatt et al. Users' guide to medical literature: how to use an article about therapy or prevention. *JAMA* 1993; 270:2598-2601.

*Begg et al. Improving the quality of reporting of randomized controlled trials. *JAMA* 1996; 276:637-639.

Buettner et al. Simvastatin and vitamin D for migraine prevention: a randomized, controlled trial. *Annals of Neurology* 2015; 78:970-981.

Lindson-Hawley et al. Gradual versus abrupt smoking cessation: a randomized, controlled noninferiority trial. *Annals of Internal Medicine* 2016; 164:585-592.

Muir et al. Allopurinol use yields potentially beneficial effects on inflammatory indices in those with recent ischemic stroke: a randomized, double-blind, placebo controlled trial. *Stroke* 2008; 39: 3303-3307.

Raskob et al. Edoxaban for venous thromboembolism in patients with cancer: results from a non-inferiority subgroup analysis of the Hokusai-VTE randomized, double-blind, double dummy trial. *Lancet Haematology* 2016; 3:e379-87.

Week 3 – Meta-Analysis

*Moher et al. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of Internal Medicine* 2009; 151:264-269.

Farrer et al. Hyperglycemia and risk of adverse perinatal outcomes: systematic review and meta-analysis. *BMJ* 2016; 354:i4694.

Hodson et al. Antiviral medications to prevent cytomegalovirus disease and early death in recipients of solid-organ transplants: a systematic review of randomized controlled trials. *Lancet* 2005; 365:2105-2115.

Jones et al. Health information technology: an updated systematic review with a focus on meaningful use. *Annals of Internal Medicine* 2014; 160:48-54.

Kamal et al. A systematic review of the effects of cancer treatment on work productivity in patients and caregivers. *Journal of Managed Care & Specialty Pharmacy* 2017; 23:136-162.

Mocellin et al. Risk-reducing medications for primary breast cancer: a network meta-analysis. *Cochrane Database of Systematic Reviews* 2019; Issue 4, Article No. CD012191.

Schottker et al. Vitamin D and mortality: meta-analysis of individual participant data from a large consortium of cohort studies from Europe and the United States. *BMJ* 2014; 348:g3656.

Zomahoun et al. Effectiveness and content analysis of interventions to enhance oral antidiabetic drug adherence in adults with type 2 diabetes: systematic review and meta-analysis. *Value-in-Health* 2015; 18:530-540.

Week 4 – Observational Studies

*Randolph et al. Users' guide to medical literature: how to use an article evaluating the clinical impact of a computer-based clinical decision support system. *JAMA* 1999; 281:67-74.

Arshad et al. Treatment with hydroxychloroquine, azithromycin, and combination in patients hospitalized with COVID-19. *International Journal of Infectious Diseases* 2020; 97: 396-403.

Fox et al. A medication therapy management program's impact on low-density lipoprotein cholesterol goal attainment in Medicare Part D patients with diabetes. *Journal of the American Pharmacists Association* 2009; 49:192-199.

Gershon et al. Combination long-acting β -agonists and inhaled corticosteroids compared with long-acting β -agonists alone in older adults with chronic obstructive pulmonary disease. *JAMA* 2014; 312: 1114-21.

Mehra et al. Cardiovascular disease, drug therapy, and mortality in COVID-19 (retracted). *New England Journal of Medicine* 2020 DOI:10.1056/NEJMc2021225.

Schelleman et al. Warfarin with fluoroquinolones, sulfonamides, or azole antifungals: interactions and the risk of hospitalization for gastrointestinal bleeding. *Clinical Pharmacology & Therapeutics* 2008; 84:581-588.

Southworth et al. Dabigatran and postmarketing reports of bleeding. *New England Journal of Medicine* 2013; 368:1272-74.

Walcher et al. Vitamin C supplement use may protect against gallstones: an observational study on a rarely selected population. *BMC Gastroenterology* 2009; 9:74-83.

Week 5 - Healthcare Leadership and Quality Improvement

*Fan et al. How to use an article about quality improvement. *JAMA* 2010; 304:2279-2287.

Bradley et al. Quality improvement efforts and hospital performance: rates of beta-blocker prescription after acute myocardial infarction. *Medical Care* 2005; 43:282-92.

O'Shea et al. Comprehensive medication reviews in long-term care facilities: history of process implementation and 2015 results. *Journal of Managed Care & Specialty Pharmacy* 2017; DOI: <https://doi.org/10.18553/jmcp.2017.23.1.22> (Links to an external site.)

Racine et al. The Canadian STOP-PAIN project: the burden of chronic pain – does sex really matter? *Clinical Journal of Pain* 2014; 30:443-452.

Schweikert et al. Quality of life several years after myocardial infarction: comparing the MONICA/KORA registry to the general population. *European Heart Journal* 2009; 30:436-443.

Week 6 - Health Economics and Policy

*Drummond et al. Users' guide to medical literature: how to use an article on economic analysis of clinical practice. *JAMA* 1997; 277:1552-1557.

*Husereau et al. Consolidated health economic evaluation reporting standards (CHEERS) – explanation and elaboration: a report of the ISPOR health economic evaluation publication guidelines good reporting task force. *Value in Health* 2013; 16:231-250.

*Sanders et al. Recommendations for conduct, methodological practices, and reporting of cost-effectiveness analyses: second panel on cost-effectiveness in health and medicine. *JAMA* 2016; 316:1093-1103.

*Wagner et al. Segmented regression analysis of interrupted time series in medication use research. *Journal of Clinical Pharmacy and Therapeutics* 2002; 27:299-309.

Chhatwal et al. Cost-effectiveness and budget impact of Hepatitis C virus treatment with sofosbuvir and ledipasvir in the United States. *Annals of Internal Medicine* 2015; 162:397-406.

Chit et al. Cost-effectiveness of high-dose versus standard-dose inactivated influenza vaccine in adults aged 65 years or older: an economic evaluation of data from a randomized controlled trial. *The Lancet* 2015(December); 15:1459-1466

Osterhoff et al. A cost-effectiveness analysis of reverse total shoulder arthroplasty versus hemiarthroplasty for the management of complex proximal humeral fractures in the elderly. *Value in Health* 2017; 20:404-411.

Brook et al. Does free care improve adults' health? Results from a randomized trial. *New England Journal of Medicine* 1983; 309:1426-34.

Morden et al. Prescription opioid use among disabled Medicare beneficiaries: intensity, trends, and regional variation. *Medical Care* 2014; 52:852-859.

Schwartz et al. Association of a community campaign for better beverage choices with beverage purchases from supermarkets. *JAMA Internal Medicine* 2017; 118:66-674.

Soumerai et al. Effects of Medicaid drug-payment limits on admission to hospitals and nursing homes. *New England Journal of Medicine* 1991; 325:1072-1077.

GUIDELINES FOR EVALUATING PARTICIPATION

Outstanding Contributor: Contributions in class reflect exceptional preparation. Ideas offered are always substantive; provide one or more major insights as well as direction for the class. Challenges are well substantiated and persuasively presented. If this person were not a member of the class, the quality of discussion would be diminished markedly.

(A range of grade)

Good Contributor: Contributions in class reflect thorough preparation. Ideas offered are usually substantive; provide good insights and sometimes direction for the class. Challenges are well substantiated and often persuasive. If this person were not a member of the class, the quality of discussion would be diminished.

(B range of grade)

Adequate Contributor: Contributions in class reflect satisfactory preparation. Ideas offered are sometimes substantive, provide generally useful insights but seldom offer a new direction for the discussion. Challenges are sometimes presented, fairly well substantiated, and are sometimes persuasive. If this person were not a member of the class, the quality of discussion would be diminished somewhat.

(C range of grade)

Non-Participant: This person says little or nothing in class. Hence, there is not an adequate basis for evaluation. If this person were not a member of the class, the quality of discussion would not be changed.

(D range of grade)

Unsatisfactory Contributor: Contributions in class reflect inadequate preparation. Ideas offered are seldom substantive; provide few if any insights and never a constructive direction for the class. Integrative comments and effective challenges are absent. If this person were not a member of the class, quality discussion time for others would increase. (Below D range of grade)