UNIVERSITY OF CALIFORNIA,
IRVINE

Active Learning for International Student Users of English as a Second Language in Higher Education: Help or Hindrance?

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Education

by

Christopher George Stillwell

Dissertation Committee:
Professor Judith Haymore Sandholtz, Chair
Professor Glenn Levine
Professor Robin Scarcella
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2018

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CURRICULUM VITAE

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EDUCATION

School of Education, University of California, Irvine
Ph.D. in Education, specializations in Learning, Cognition, & Development/Language, Literacy, & Technology — *June 2018*
M.A. in Education — *December 2014*

Teachers College, Columbia University, New York — *June 2005*
M.A. in TESOL, supplementary concentration in Conflict Resolution

University of Pennsylvania, Philadelphia, PA — *May 1994*
B.A. in Theatre Arts (with honors) and Psychology
magna cum laude, Spanish proficiency

AWARDS

- Named to TESOL International's 50th anniversary list of "30 Up and Coming" TESOL professionals, "the next generation in research, teaching, publishing, and leadership."
- Edited a volume that was shortlisted for British Council/Cambridge ESOL International's ELTon Award for Innovation in Teacher Resources, 2014. Contributed chapters to two shortlisted books as well (2011, 2015).
- UC Irvine Most Promising Future Faculty Member award and fellowship, 2017.
- UC Irvine Associated Doctoral Students in Education Service Award, 2017.
- TESOL Doctoral Forum Best Proposal award, 2017.
- UC Irvine Graduate Research Symposium: Judge's Prize, 2015; Audience Choice Award; 2016.
- UC Irvine Elevator Pitch Competition: First prize, 2015.
- "Best of Japan Association of Language Teachers": Two awards for invited presentations, 2011.
- Teachers College John Fanselow Award for Teaching Excellence and Instructional Design, 2005.

PUBLICATIONS

Books

(2015) (Editor/Contributor) *Language Teaching Insights from Other Fields: Psychology, Business, Brain Science, and More*. Alexandria, VA: TESOL.

(2013) (Editor/Contributor) *Language Teaching Insights from Other Fields: Sports, Arts, Design, and More*. Alexandria, VA: TESOL. ***Shortlisted for ELTon Award for Innovation in Teacher Resources.***

Peer-Reviewed Journal Articles

(2016) Challenges to the implementation of youth PAR in a university-middle school partnership. In *i.e.: inquiry in education, 8*(1), 2.

(2011) Reading discussion groups for teachers: Connecting theory to practice. *ELT Journal, 65*(3). With B. Fenton-Smith.

(2010) Students transcribing tasks: Noticing fluency, accuracy and complexity. *ELT Journal, 64*(4). With B. Curabba, K. Alexander, A. Kidd, E. Kim, P. Stone, and C. Wyle.

(2009) The collaborative development of teacher training skills. *ELT Journal, 63*(4).

Additional Articles and Book Chapters

(2017) Supporting lecturers and learners in the use of English as medium of instruction. In M. A. Snow and D. Brinton (Eds.), *The Content-Based Classroom: Perspectives on Integrating Language and Content* (2nd ed.). Ann Arbor, MI: University of Michigan Press.

(2017) Professional development for English as medium of instruction: Exploring Taiwanese lecturers' needs. In B. Fenton-Smith, P. Humphreys, and I. Walkinshaw (Eds.), *English as a Medium of Instruction in Higher Education in Asia-Pacific: Issues and Challenges.* New York: Springer. With B. Fenton-Smith.

(2017) Do you hear what I hear? Discussing the pieces in a musical ensemble. In E. Herrick and J. Arnold (Eds.) *New Ways in Teaching with Music*. Alexandria, VA: TESOL.

(2015) How would a vacuum cleaner salesman introduce a book on language teaching insights? In C. Stillwell (Ed.), *Language Teaching Insights from Other Fields: Psychology, Business, Brain Science, and More*. Alexandria, VA: TESOL.

(2014) Pause and respond. In C. Chan and E. Frendo (Eds.), *New Ways in Teaching Business English*. Alexandria, VA: TESOL ***Book shortlisted for ELTon Award.***

(2014) Note-taking secrets of success. In C. Chan and E. Frendo (Eds.), *New Ways in Teaching Business English*. Alexandria, VA: TESOL. With B. McMillan.

(2013) Enhancing teaching with the fruits of distant fields. In C. Stillwell (Ed.), *Language Teaching Insights from Other Fields: Sports, Arts, Design, and More*. Alexandria, VA: TESOL.

(2013) How would an actor teach language learners to improvise and fluently speak the speech? In C. Stillwell (Ed.), *Language Teaching Insights from Other Fields: Sports, Arts, Design, and More*. Alexandria, VA: TESOL.

(2012) Scan and you shall 'find.' In R. Day (Ed.), *New Ways in Teaching Reading, Revised Edition.* Alexandria, VA: TESOL.

(2012) Sharing experiences with quantitative research. *JALT 2011 Conference Proceedings.* Featured in "A Taste of JALT2011." *The Language Teacher, (36)*5. With G. Sholdt, B. Konomoto, and M. Mineshima.

(2012) Avoiding burnout by starting fires. In C. Coombe, L. England, and J. Schmidt (Eds.), *Reigniting, Retooling and Retiring in English Language Teaching*. Ann Arbor, MI: University of Michigan Press. With J. Falout and T. Murphey.

(2012) Does the devil laugh when team teachers make plans? In A. Honigsfeld and M. Dove (Eds.), *Co-teaching and Other Collaborative Practices in the EFL/ESL Classroom: Rationale, Research, Reflections, and Recommendations*. Charlotte, NC: Information Age Publishing.

(2011) What administrators can do to promote collaborative professional development. In C. Coombe, L. Stephenson, and S. Abu-Rmaileh (Eds.), *Leadership and Management in English Language Teaching*. Dubai: TESOL Arabia. With T. Murphey.

(2010) Embracing the challenges of movie and television listening. In N. Ashcraft and A. Tran (Eds.), *Teaching Listening: Voices from the Field*. Alexandria, VA: TESOL.

(2010) Don't ask, don't tell: Asking questions effectively in the language classroom. *Language Magazine*. *10*(4).

(2010) Four teachers looking for a lesson: Developing materials with lesson study. In B. Tomlinson and H. Masuhara (Eds.), *Research for Materials Development: Evidence for Good Practice.* London: Continuum. With H. Gillies, B. McMillan, and T. Waller.

(2010) Mutual benefits of feedback on materials: Collaborative materials evaluation. In B. Tomlinson and H. Masuhara (Eds.), *Research for Materials Development: Evidence for Good Practice.* London: Continuum. With A. Kidd, K. Alexander, T. McIlroy, J. Roloff, and P. Stone.

(2010) Danger learning: Experiencing ESL through conflict resolution techniques. In J. Nordmeyer and S. Barduhn (Eds.), *Integrating Language and Content*. Alexandria, VA: TESOL. ***Book Shortlisted for ELTon Award.***

(2010) We're going to Englishland! Class trips abroad at home. *The Language Teacher, 34*(5).

(2010) Taking action on professional development. *JALT2009 Conference Proceedings.* With B. Fenton-Smith, D. Rivers, D. Bollen, S. Cook, and K. Yamamoto.

(2010) Promoting autonomy through self-access materials design. *JALT2009 Conference Proceedings.* With M. Kershaw, J. Mynard, L. Promnitz-Hayashi, M. Sakaguchi, A. Slobodniuk, and K. Yamamoto.

(2009) Teachers' perspectives on professional development. *Studies in Linguistics & Language Teaching*, *20*.

(2009) Role playing with fire: Hot topics and heated discussions. In A. Smith and G. Strong (Eds.), *Adult Language Learners: Context and Innovation*. Alexandria, VA: TESOL.

(2009) Authentic video as passport to cultural participation and understanding. In S. Rilling and M. Dantas-Whitney (Eds.), *Authenticity in the Language Classroom and Beyond: Adult Learners*. Alexandria, VA: TESOL.

(2009) Speaking the reading: Orally reconstructing written texts. In L. Savova (Ed.), *Using Textbooks Effectively*. Alexandria, VA: TESOL.

(2009) Cross-departmental materials development through lesson study. *Journal of Kanda University of International Studies, 21*. With M. Bachner-Reimer, D. Bollen, B. McMillan, and T. Waller.

(2009) Book review: *Presentation Zen: Simple Ideas on Presentation Design and Delivery. The Language Teacher, 33*(3). With M. Trovela and T. Murphey.

(2008) Networks of collaborative professional development. *Studies in Linguistics & Language Teaching*, *19*.

(2008) Member's profile: Christopher Stillwell. *The Language Teacher, 32*(8).

(2008) Language, cameras, reaction: Raising awareness of first and second language choices through documentary filmmaking. In T. Farrell (Ed.), *Classroom Management*. Alexandria, VA: TESOL. With H. Gillies.

(2008) The six most common verbs followed by gerunds. *Studies in Linguistics & Language Teaching, 19.*
(2008) A mentor development program for EFL teachers. *Research Institute of Language Studies Working Papers, 14.*
(2007) From isolation to collaboration through lesson study. *JALT 2007 Conference Proceedings*. With H. Gillies, B. McMillan, and T. Waller.
(2007) Lesson study as means of professional development. *Research Institute of Language Studies Working Papers, 14.* With H. Gillies, B. McMillan, and T. Waller.

PROFESSIONAL

University of California, Irvine

Lecturer, Division of Continuing Education *July 2013 – Present*

- Teach online TESOL certificate courses in Listening & Speaking and in Writing & Vocabulary
- Gave guest lectures for TEFL certificate program.
- Taught specialized TEFL classroom practices classes to teacher cohorts from China, Brazil, Taiwan, Japan.
- Taught ESL listening, speaking, reading, writing, idioms, film, and pronunciation classes in summer intensive courses.

English Mediated Instruction Specialist, UCI/Meiji University, Japan *Mar. 2016, 2017, 2018*
Providence University, Taiwan program at UC Irvine *Summer 2014*

- Assessed needs of university lecturers who use English as medium of instruction
- Tailored and administered intensive professional development programs

Teaching Assistant, School of Education *Sept. 2012 – June 2018*

- Co-taught "Multicultural Education." Student evaluations between 3.51 and 3.86 on a 4-point scale.
- Served on instructional teams for "Educational Technology Online," "Advanced Concepts in Learning & Cognition," "Ethics in Education," and more, with student evaluations above 8 on a 9-point scale.

Researcher, School of Education/Crystal Cove Alliance *January 2016 – September 2016*

- Trained undergraduates to be educational research assistants and coordinated their involvement in research projects.
- Developed and administered surveys, conducted interviews. Organized and analyzed data.
- Maintained organization of lab materials including space, documents, and resources.
- Co-developed and taught informal science learning experiences for minority 4th grade students.

Ain Shams University, Cairo, Egypt

English Language Specialist, U.S. Department of State *Summer 2017*

- Established a virtual exchange between TESOL certificate participants in Cairo and the US to promote professional development and mutual understanding.
- Revised curriculum of Ain Shams University's Certificate in English Teaching (ASUCET), an affordable program for local language teachers at elementary schools and universities, supported by US Embassy.
- Created and co-taught core program lessons. Facilitated reflection and feedback on participants' teaching.
- Link: https://www.facebook.com/ReloCairo/videos/1305663959562133/

Sojo University, Kumamoto, Japan

Assistant Director, Sojo International Language Center *December 2009 – March 2012*

- Consulted on design of all facilities during planning stages.
- Set curriculum guidelines and coordinated curriculum development.
- Oversaw final assessment for over 1,200 students enrolled in the language classes.
- Guided and conducted curriculum-related research.
- Facilitated use of technology in the classroom, including Moodle, PowerPoint, mp3 recorders.
- Taught courses in basic and intermediate English communication to technical school students.
- Observed teachers and held conferences to promote professional development.
- Held discussions of professional literature with teachers on site and at sister institution via Skype.

Kanda University of International Studies, Chiba, Japan

Research Project Coordinator *February 2008 – January 2010*

- Led curriculum research projects, culminating in curricular improvements and collaborative publications.
- Managed Freshman English program's communicative curriculum.
- Implemented curriculum review.

Teacher Educator, Collaborative PD Facilitator *April 2006 – January 2010*

- Created and coordinated Mentor Development Program. Facilitated peer observation, collaborative development of teacher education skills, and discussions of current literature.
- Organized collaborative peer workshops, guest speaker visits, and student depression workshops.
- Gave teacher education workshops to Japanese teachers at Kanda Institute of Foreign Languages and on behalf of the Sano Foundation in various cities in Japan, as well as to peers in-house.
- Taught undergraduate class on ESL/EFL teaching.

Lecturer *March 2006 – January 2010, September 2011*

- Taught Freshman English and elective classes, created original material.
- Tutored students in the Writing Center and Speaking Center.
- Conducted research on tasks, curriculum development, use of authentic materials, lesson study, teacher observation, collaborative professional development.
- Taught summer intensive elective courses on creativity and language learning.

Materials Designer *March 2006 – February 2010*

- Developed materials for self-access center, produced filmed library of workshops, and facilitated student creation of materials.

Teachers College, Columbia University, New York, NY

Guest Lecturer *Summer 2005, 2006; Spring 2008 – 2012*

- Gave workshops for Community English Program and TESOL Certificate Program on peer observation, creativity, and using authentic video

Peace Corps Fellows Mentor *Fall 2005, Spring 2006*

- Observed Teachers College Peace Corps Fellow teachers in New York public schools.
- Held post-observation conferences to discuss, reflect, set goals, and stimulate enthusiasm.

Master Teacher *Fall 2005, Spring 2006*

- Established the role of Master Teacher as one of the Community English Program's (CEP) first.
- Served as model ESL teacher, observed extensively by TESOL graduate students.
- Held post-class discussions with observers to reflect on effective teaching practices.
- Conducted teacher observations and program evaluation, and provided curricular supplements.

Instructor, Graduate Practicum on Integrated Skills *Summer Term 2005*

- Developed curriculum, gave lectures, facilitated online discussions.
- Observed 17 MA candidate teachers per week, with regular meetings to reflect on teaching practices.

Pace University, New York, NY *February – March 2006*

- Gave teacher education workshops in listening, speaking, reading and writing for novice teachers.

The New York Times, New York, NY *March 2008 – May 2009*

- Consulted for ESOL Initiative, promoting language learning through New York Times content.

Intensive English Program and Community College Instructor

Cambridge Schools, New York, NY — *Mar. 1996 – June 2005, Feb. 2006, Feb. 2007*
Westchester Community College, New Rochelle, NY — *February 2005 – May 2005*
JC Education Center, Queens, NY — *February 1996 – January 1997*
International English Center, Newark, NJ — *August 1995 – January 1996*
Academia Farideh, Alcobendas, Spain — *September 1994 – June 1995*

PRESENTER

- Facebook Live/Zoom presentation for U.S. Department of State's American English Live Teacher Development: "Strategies for Teaching Large Classes," with live audience of approximately 10,000
- 88 presentations and workshops at 48 conferences throughout Asia and the US, including TESOL, AAAL, AERA and JALT conferences.
- Webinars/virtual seminars for TESOL International ("Teacher Observation," "Language Teaching Insights from Other Fields") and California TESOL ("Using Authentic Video").
- 34 invited presentations at universities and professional meetings, including Teachers College New York and Tokyo campuses. Winner of 5 awards for outstanding presentations and workshops. (*see above*)
- Invited speaker, TESOL International Convention, Portland, OR 2014: "Theater Techniques in TESOL"
- Featured speaker, OC CATESOL biannual professional development seminars, Biola University, 2014; NOCCCD Anaheim, Feb. 10, 2018
- Topics include: English as Medium of Instruction in higher education, teacher observation, conflict resolution skills for educators, creativity, use of authentic material, integrated skills, lesson study, materials design, facilitating discussions, adapting textbooks, classroom management, group dynamics.

FUNDING

University of California, Irvine

- Most Promising Future Faculty Fellowship, 2017 ($6,729, plus tuition and fees for one quarter)
- Multidisciplinary Design Program: 2018 ($2,500), 2017 ($2,500)
- UCI Travel Grants: 2017 ($400), 2016 ($400)

Kanda University of International Studies

- Research Institute of Language Studies Grants: 2010-2012 (240,000 JPY), 2009-2010 (90,000 JPY), 2007-2009 (145,000 JPY)

ADDITIONAL EDUCATION

UC Irvine/Orange County Human Relations Basic Mediation Training — *Fall 2013*
UC Irvine Graduate Public Speaking Intensive — *Fall 2013*

SERVICE

TESOL Quarterly, Columbian Applied Linguistics Journal
Invited manuscript reviewer

UC Irvine School of Education, Irvine, CA
Coordinate topical faculty talks for greater university audience — *November 2016 – June 2018*
Member of Diverse Educational Community and Doctoral Experience (DECADE) diversity council — *November 2016 – June 2018*
Associated Doctoral Students in Education representative — *September 2014 - September 2015*

UC Irvine Division of Continuing Education, Irvine, CA — *January 2016 – Present*
TESOL Online Certificate Advisory Committee Member

Orange County CATESOL — *Sept. 2014 – June 2018*
Board Member

Spurgeon Intermediate, Santa Ana, CA
Facilitator of Youth Participatory Action Research — *Fall 2013*

Secondary/Tertiary Schools, Vientiane, Laos
Consultant/Teacher Educator (Volunteer) — *February 2012*

PeerSpectives (Teacher Development Serial Publication)
Co-Editor (with Tim Murphey) — *2008-2010*

JALT Teacher Education Special Interest Group
Program Chair — *2008*
Co-Coordinator — *2007*

TESOL/AL Times: Teachers College, Columbia University Newsletter
Editor — *2004 – 2005*

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS

Teachers of English to Speakers of Other Languages (TESOL) (2005 – present)
American Association of Applied Linguistics (AAAL) (2009 – 2010, 2015 – present)
California Association of Teachers of English to Speakers of Other Languages (CATESOL) (2013 – present)
American Educational Research Association (AERA) (2014 – 2015)
Japan Association of Language Teachers (JALT) (2007 – 2012)
New York State Teachers of English to Speakers of Other Languages (NYS-TESOL) (2005 – 2007)

ABSTRACT OF THE DISSERTATION

Active Learning for International Student Users of English as a Second Language in Higher Education: Help or Hindrance?

By

Christopher George Stillwell

Doctor of Philosophy in Education

University of California, Irvine, 2018

Professor Judith Haymore Sandholtz, Chair

In STEM fields of higher education, complex content and low rates of student persistence have led to the use of active learning practices to help students engage with and understand course material. Although research indicates that these practices are generally effective, there is cause for concern that they may be ill-suited to second language users of English who are international students (ISs), particularly if these students prefer traditional instruction or lack confidence in their speaking skills. To investigate this concern, this mixed-methods, classroom-based study examines the case of a large undergraduate introductory biology course characterized by the use of such active learning components as open discussion, clickers, peer instruction, small group work, and collaborative quizzes, all supported by a highly structured course design and multiple online and face-to-face supplementary resources. Course enrollment included dozens of first-year ISs, many of whom were from China.

Drawing on institutional data, grades, survey responses, interviews with students and instructional staff, field notes, and other data, this study investigates the impact of active learning on ISs' content and language development. Comparison of grades reveals that ISs performed approximately as well as their non-IS peers in this context, but multiple linear regression analysis shows that ISs' grades were low relative to their non-linguistic academic ability as represented by their SAT math scores. Language skill appeared to have had an impact on their achievement, as there was a significant positive relationship between IS's TOEFL scores and their grades. Constructivist analysis of open-ended data suggests that ISs generally found active learning beneficial, but that reluctance to speak could impact their participation. They reported that the greatest language challenges were related to vocabulary, speaking, and reading, and that such course components as pre-lecture lists of key terms, supplementary reading guides, peer instruction, and collaborative quizzes helped them learn the content and develop language skills. In addition, Chinese students accessed valuable extra-curricular support within their L1 community by communicating via the social media app WeChat. Taken together, the analysis suggests that active learning practices hold potential benefits for ISs, but that adaptations may be necessary to maximize their effectiveness.

Chapter 1: Introduction

In STEM fields, complex content and low rates of student persistence in higher education across all demographics have led to calls for educators to employ innovative approaches as means of helping students engage and understand course material (Brewer & Smith, 2011; Cech & Kennedy, 2005; Olson & Riordan, 2012). "Active learning" practices are among the most commonly cited of these innovations, and though the research is generally indicative of their effectiveness (Bonwell & Eison, 1991; Fairweather, 2008; Knight & Wood, 2005; Kuh, Kinzie, Schuh, & Witt, 2005; Pascarella & Terenzini, 2005; Prince, 2004), their value for supporting second language (L2) users of English who are international students in these contexts is largely unknown. These practices include the use of clickers, peer instruction, class discussion, small group work, and other departures from traditional transmissionist, exposition-centered instruction (i.e., lectures). Insofar as these practices make use of collaborative learning, and parallel the student-centered pedagogy that has become the norm in modern English as a Second/Foreign Language (ESL/EFL) instruction, we may expect them to be ideally suited to ISs, and we may even expect those ISs who have experienced such student-centered language instruction to be able to draw from these prior learning experiences to facilitate their success (Muñoz, 2004). However, there are reasons to believe that the benefits of such pedagogical approaches may be dependent on cultural background (see, e.g., Bowers, 2005), as students from traditional educational backgrounds may prefer teacher-centered approaches to education, and may fear loss of face during interaction with IS and non-IS peers, among other concerns. Answers to these questions are not presently available. More data on ISs in higher

education are necessary (Núñez, Rios-Aguilar, Kanno, & Flores, 2016), including classroom-based research that identifies just how learners perform in a context defined by the use of active learning and other instructional supplements and innovations, with a focus on the extent to which ISs may be advantaged or disadvantaged by their use.

This classroom-based study uses a mixed methods approach to offer an in-depth look at these students' responses to the use of such instructional innovations in a large introductory biology course at a public university in the U.S., identifying the constraints and affordances of such practices when it comes to the learning of content via English as an additional language.

Purpose and Significance of the Study

This study will investigate the impact that active learning activities, as well as other unique features of a class designed to increase student persistence, have on international students in higher education. International students (ISs) are here defined as L2 English users enrolled in full-time degree-seeking programs who were born in a country where English is not the dominant local language, and who migrated to the U.S. shortly before attending (i.e., no earlier than high school). This study will focus on the way ISs' content and language learning may be facilitated or impeded by the use of active learning and other instructional innovations. If these practices are found to be beneficial for ISs, there may be further impetus for them to be employed in universities, not only out of concern for these ISs but because accommodations made for one group frequently amount to good pedagogy for all (Zamel, 2004). Such practices may be particularly important for institutions of higher education fighting to attract and sustain IS enrollment in the midst of the current unwelcoming political climate in the U.S. (Kopf, 2016).

If these practices should prove beneficial to ISs in the U.S. context, there may also be reason to consider their use in other contexts abroad, for the experience of ISs in the U.S. parallels that of students who travel to other non-Anglophone contexts in which English is used as the medium of instruction (EMI) in numerous relevant ways (Byun et al., 2011; Doiz, Lasagabaster, & Sierra, 2012). In addition to facing similar language-related challenges, students in EMI contexts similarly have access to only limited first language (L1) resources, and they also often have instructors who lack the pedagogical training to adapt instruction to meet their needs. Indeed, Dearden's (2015) study of the implementation of EMI in 55 countries, including the U.S., found that instructors are typically unprepared to meet the needs of EMI learners, and Unterberger and Wilhelmer (2011) lament that EMI instructors often lack even basic teaching competencies. Compounding the issue is that instructors in higher education the world over may express little concern for the needs of ISs in their midst (Airey, 2012; Dearden, 2014; Snow, 1997; Srole, 1997), as "the central focus is on students' content mastery and no language aims are specified... the emphasis is almost exclusively on the transmission of subject-specific knowledge" (Unterberger & Wilhelmer, 2011, p. 96).

Snow (1997) suggests that addressing these concerns may require convincing instructors that supporting ISs can be a means of helping students master content better, thus making courses more rigorous, not less. Active learning and other instructional innovations may provide a reasonably straightforward means of doing so, but research is necessary to determine just what impact they have on ISs.

Research Questions

To increase understanding of the impact of active learning and other course supplements and innovations on the performance of ISs in higher education, this mixed methods, classroom-based study investigates a large (i.e., enrollment over 400) introductory biology course taught in an Anglophone university context, focusing on the following questions:

1. In comparison to their English-dominant domestic peers, how well do ISs perform in a biology course taught through the use of active learning?
2. For these ISs, how are factors such as English language proficiency, academic ability, and receptiveness to active learning associated with their performance in the course?
3. What are the ways in which ISs engage in the class during time dedicated to active learning? What are ISs' perceptions of the utility of these practices?
4. What resources and components of the class do ISs use to support their content learning in this context of active learning? What are ISs' perspectives on the utility of these resources and components?
5. What are the language-related challenges and opportunities associated with the class, from the perspective of the ISs and the instructional staff?

Overview of Dissertation Chapters

In the next chapter I provide a review of the literature on international students in higher education, focusing on their learning contexts as well as their educational backgrounds, needs, and preferences. I also review the literature on active learning in STEM higher education, including use of discussion, clickers, peer instruction, and small group work, as well as the impact of employing these activities within a highly structured course design.

In chapter three I distill the review of the literature into the conceptual framework that drives this study, focusing on the components unique to the classroom setting under investigation, and the impact these components may be expected to have on ISs.

In chapter four I detail the methodology employed, including a description of the setting, explanation of how samples and interview participants were selected, explanation of the quantitative and qualitative methods employed, and consideration of the assumptions and limitations of the study.

In chapter five I report the findings from my statistical analysis to investigate the first two research questions, regarding ISs' academic performance in the class in comparison to English-dominant domestic peers and in relation to the ISs' individual characteristics (i.e., language proficiency, academic ability, and receptivity to active learning).

In chapter six I address the third research question, probing ISs' accounts of how they engage with active learning, as well as their perceptions of how various active learning components of the course contributed to their comprehension of course content.

In chapter seven I examine other resources and course components that supplemented the use of active learning in the course, investigating ISs' accounts of how they made use of these resources, and uncovering alternative resources that many ISs preferred to use on their own.

In chapter eight I share findings in response to the fifth research question, regarding the language-related challenges and opportunities that the course posed for these ISs. For this

analysis I draw from ISs' own perspectives, the perspectives of the instructional staff members, and my own observations.

In chapter nine I review the findings from chapters five through eight and discuss the implications for the instruction of ISs in higher education, with suggestions for further research.

Chapter Two: Background and Literature Review

This dissertation focuses on the experiences and performance of ISs in the setting of an introductory biology course taught with the aim of increasing student persistence through various innovations and supplements. These means include the provision of various forms of support, as well as the use of active learning practices, such as the use of clickers, cooperative learning, and other ways of breaking out of the traditional teacher-centered lecture mold. As such, the analysis is primarily informed by literatures regarding international students in higher education, and innovations in STEM instruction in higher education.

International Students in Higher Education

For years, the population of international students attending higher education in the U.S. has been increasing. The number was over one million in 2016, when international students (including those who were L1 users of English) accounted for 5.2% of all students in U.S. higher education (Institute of International Education, 2016)[1], with the majority attending schools in California (NAFSA Association of International Educators, 2016). By their very presence, these students enrich the cultural and intellectual environment of their academic communities (Jones & Kim, 2013), helping institutions of higher education meet goals of developing all students' cultural competence and capacity to work with people from different backgrounds (Zhao, Khu, & Carini, 2005). In addition, these international students bring important economic benefits, supporting over 400,000 jobs and bringing as much as $32.8

[1] Recent changes in the U.S. political landscape appear to be having a dampening effect on these enrollment numbers, by some measures (Saul, 2018).

billion in economic benefits (NAFSA Association of International Educators, 2016). In fact, for some institutions of higher education, the higher tuition rates these students pay becomes a necessity to help subsidize the education of local students (Kopf, 2016).

Needs of ISs in U.S. Higher Education

The cultural, intellectual, and economic benefits these students bring come at great personal cost, as they face challenges regarding language, integration, and adjustment (Dillon & Swann, 1997; Heikinheimo & Shute, 1986; Ramsay, Barker, & Jones, 1999).

Language*.* Many of these international students who are L2 users of English (ISs) could be considered "eye learners" because of the way their EFL studies tend to place greater emphasis on reading and writing than on listening and speaking (Ferris, 2009; Leki, 1992; Reid, 1997; Wright, 2010). As a result, many have difficulty listening to lectures and interacting in discussions. As a student from Japan stated, "It has been pain for me to speak up in the class for four years in college and still cannot solve it" (Disch, 2004, p. 194). A telling example comes from Airey's (2009) comparison of students' performances in content courses taught through English as the medium of instruction (EMI) and non-EMI content courses taught through students' L1 in Sweden. Airey found that even though these students were quite fluent in English, their performance in the course was impacted by the use of their L2. In the EMI courses, students were less likely to ask and answer questions. Said one, "When he asked a question I was pretty certain I knew the answer but because it was English and so on you worried that it perhaps wasn't quite that he was looking for. Um, you get a little uncertain" (Airey & Linder, 2006, p. 556). Furthermore, students reported that their note-taking skills were

negatively impacted such that they could not both take notes and comprehend what the lecture was about. Given that students from Sweden are widely believed to be among the strongest speakers of English as a foreign language, we might expect these problems to be even more prevalent for students whose English language proficiency is not as well-developed.

Reports of non-Anglophone programs that use EMI provide further information on the challenges students face as they seek to learn content through English as an additional language, indicating that such students will struggle if they do not have the capacity to handle high cognitive processing loads (Marsh & Laitinen, 2005), as well as sufficient strength in terms of concentration, attention span, and listening comprehension (Klaassen & de Graaff, 2001). Content comprehension difficulties and secondary problems such as students' self-perceptions of their own inadequacy may be associated with further issues, such as learning difficulties (Yeh, 2014) and learning anxiety (Huang, 2015). In addition, underprepared students may be demoralized by discipline-specific readings at a high level of difficulty. For all of these reasons and more, students may lose confidence and fail to adapt (Smith, 2004), and ultimately students may fail to acquire the targeted academic knowledge and language skills (Shohamy, 2012). As a result of these challenges, students who are ordinarily accustomed to academic success in their home countries may suddenly find themselves at risk of failure (Ryan, 2007).

Integration. Though they may have been in a dominant position in their home countries, on arrival to the U.S. these ISs may face the shock of becoming minorities (Ryan, 2007). In addition, ISs may have difficulty integrating with domestic peers who fail to see the benefit of interacting with them (Jones & Kim, 2013). Feelings of fear and inadequacy can result, as ISs

find that they have only limited opportunities for involvement and inclusion (Zamel, 2004). According to students interviewed by Jones and Kim (2013), “Sometimes [American students] do not want to listen to you. They don’t have the patience to listen what you are talking...they just stay silent…sometimes they are laughing. That’s very uncomfortable” (p. 93). In addition,

> If I am just sitting in a classroom and I’m the American student, there is an American student to my left and on my right, there is a Chinese student. Mostly the American student will talk to the American student instead of the Chinese student. I don’t know why. (p. 94)

When integration fails to ignite, endeavors to meet institutional objectives of internationalization and intercultural exchange fall short (Zhao et al., 2005).

Adjustment. ISs, ambassadors who will return to their home countries and share stories of their experiences in American culture, need time and support as they adjust to a different education system (Ferris, 2009). The language, academic, and social needs of these ISs differ in accordance with many factors, including the students’ country of origin (Doiz et al., 2012). We may consider the example of Chinese students, the largest segment of ISs in the U.S. (NAFSA Association of International Educators, 2016), at over 300,000 students (Institute of International Education, 2016). These students may find that the training they received for TOEFL and GRE exams in their home country was inadequate to meet the academic demands of their studies abroad, and that it did little to prepare them for the complexities of social interaction (Yan & Berliner, 2016). Language proficiency issues may pose a great barrier to their academic adjustment (Lu, 2002; Wang, 2003), and these students may also face difficulty

adjusting to the self-directedness of U.S. schooling, being previously accustomed to having mentors and instructors tell them what to do (Yan & Berliner, 2016).

Structure. International students may also face challenges navigating a school culture that is distinct from what they have previously experienced. As such, these students may benefit from exposure to instructors who act as cultural informants, people who provide insight and support that can help students get acclimated and perform at their best. An explicitly structured approach can help, in which students are given instruction regarding the norms of U.S. education through explicit syllabi, the breaking of large assignments into smaller sub-assignments with distinct deadlines, and mandatory visits to teachers' office hours that are scaffolded through sample scripts that demonstrate the typical protocol of such visits (Koch et al., 1997; Snow, 1997; Srole, 1997).

Danger of deficit assessments. As is the danger with any warts-and-all assessment of a group's needs, there is a risk that the group may come to be viewed solely in terms of the challenges they face, and for their responses to these challenges to be construed as deficits. This can certainly be the case with ISs learning in higher education (Harklau, 2000). Thinking in terms of ISs' deficits "blinds us to the logic, intelligence, and richness of students' processes and knowledge" (Zamel, 2004, p. 13). It would be best for all who interact with these students to remember that they are generally hard-working, bright, and motivated (Ferris, 2009), and they yearn to be understood as much more than the sum of the challenges they face. As one international student expressed in comments addressed to instructors:

> I would like them to know that we are very responsible and we know why we come to college: to learn. We are learning English as well as the major of our choice. It is very hard sometimes and we don't need professors who claimed that they don't understand us. The effort is double. We are very intelligent people. We deserve better considerations…. ESL students are very competent and deserve to be in college. We made the step to college. Please make the other step to meet us. (Zamel, 2004, pp. 8-9)

In light of such commentary, Kanno and Varghese (2010) pointedly suggest that it may be time that everyone, including college instructors, shifted from "blaming ESL students for their inability to *learn* and started questioning their inability to *teach*" (p. 325).

The Role of Instructors

Instructors who care about educating all of their students must thus consider ways of calibrating their instruction to the needs of these students, but this endeavor is fraught with challenges. These challenges include instructors' lack of awareness regarding the impact learning content through a foreign language has on students, lack of time for and/or interest in making adjustments to instructional practices, and lack of guidance regarding appropriate instructional practices for supporting these learners.

Lack of awareness. In her overview of the use of EMI in higher education around the world, including in the U.S., Dearden (2014) found that lecturers' awareness of the implications of teaching and learning content through a language that is not the students' L1 was extremely limited. For instance, in non-Anglophone contexts she found that "few teachers had considered the idea that EMI was not simply a matter of translating course material and slides from L1 to L2." Similarly, Coleman (2006) notes that instructors teaching content in a language that is not the students' primary language often fail to fully appreciate the particular demands that higher

education in a second language brings. Given that U.S. lecturers do not ordinarily receive preparation to work with ISs, we may expect that they would similarly fail to fully appreciate these particular demands.

Inability to make adjustments*.* Compounding the challenges is the fact that lecturers are typically hard-pressed to "cover" all of the course material and meet all the goals that their syllabi require. In addition, "didactical competence and methodological skills are often neglected in higher education and certainly do not get as much attention as on the secondary level" (Unterberger & Wilhelmer, 2011, p. 97). As a result, the efforts necessary to meet the needs of students learning through an additional language may place heavy additional burdens on instructors whose existing teaching capacities may already be underdeveloped and stretched thin. Perhaps in response to these circumstances, many lecturers express little concern over language learning outcomes, focusing instead on their particular content area (Airey, 2012). Dearden (2014) reports, "EMI teachers firmly believed that teaching English was not their job... They did not see themselves as language teachers in any way… *'I'm not interested in their English, I'm interested in their comprehension of micro-biogenetics*,'" (p. 6, emphasis in original) said one. Snow (1997) encountered identical sentiments at a university in California, as faculty members expressed their resistance to taking responsibility for supporting ISs, saying, "I'm an Economics professor. You can't expect me to become an English teacher, and anyway, I don't have the time" (p. 290). Srole (1997), working in the same setting, observed that university faculty from the history department felt similarly:

> Neither trained nor interested in teaching remedial skills, faculty ... lament [their] own lack of suitable training, [and] shun "handholding" ... Ultimately, university professors fear that confronting the educational demands of these new student populations sacrifices course content and lowers university standards. (p. 105)

On the other hand, curtailing curricular territory to a strict content focus limits students' language learning opportunities (Tan, 2011). Dearden (2014) notes:

> We may ask how students are supposed to understand lectures and classes if the EMI teacher does not help with their knowledge of English by paraphrasing, by teaching subject-specific vocabulary and technical terms… If subject teachers do not consider it their job to improve the students' English, whose job is it? (p. 6)

Although lecturers may believe that the responsibility for supporting students' English language learning should fall to language specialists, collaboration between content and language educators is rare in higher education (Costa & Coleman, 2010; Dearden, 2014; Tan, 2011). Ultimately, whether lecturers see language support as a part of their jobs or not, they are sure to find their effectiveness diminished when language difficulties impede students' comprehension of content (Snow, 1997).

Lack of appropriate teaching practices. A large question remains regarding the best ways of teaching students who are learning through a language that is not their L1, for guidance is rarely available. Dearden's (2014) study found that 60 percent of the countries in her survey have no national guidelines on how to teach through EMI. Where guidelines and policies are articulated, they may be driven by curriculum planners' need to put forth ambitious goals (Marsh, 1991), which can exacerbate issues with what Wankat and Oreovicz (1997) refer to as "content tyranny." In addition, lecturers may either be unaware of the existence of such

guidelines, or they may encounter policies that are unrealistically demanding or overly vague. In the U.S., reports regarding how individual lecturers can support ISs in higher education are no more common, though adjunct models in which language specialists teach courses that supplement the content courses can help (see, e.g., Goldstein, 2017). In addition, accounts of Project LEAP, an extensive program of collaboration between language specialists and content instructors at a university in Los Angeles, offer a range of practical ideas (see, e.g., Snow, 1997; Snow & Kamhi-Stein, 2002; Stillwell, 2017).

Otherwise, research typically only contributes indirectly, as in the implications sections of papers. Suggestions of this nature include:

-firmly require students to read (and attempt to understand) content before class, so that class time can be used to allow students to confirm and clarify what they have already seen. This seemingly obvious idea is said to carry great importance because for students learning content through a foreign language, lectures are a poor way to introduce topics, "since students may have difficulty following and taking notes at the same time" (Airey, 2009, p. 83), as noted above.

-aid students in understanding lectures by providing an agenda for students to follow, and provide support for note-taking (Snow, 1997) such as handouts and slides (Airey, 2009).

-dedicate time for collaborative "buzz groups," in which students collaboratively answer questions and come up with new ones (Airey, 2009), perhaps at the beginning of each class to review the previous lecture (Snow, 1997).

-adopt a range of questioning techniques to make up for ISs' frequent reluctance to ask and answer questions in content classes (Airey, 2009)

-use students' first language as a resource for learning (e.g., Chromá, 2006; García & Sylvan, 2011; Hornberger & Vaish, 2009; Levine, 2011; van der Walt & Kidd, 2012) and embrace translanguaging practices that access learners' dynamic linguistic resources (García & Wei, 2014). As Doiz, Lasagabaster, and Sierra (2012, p. 218) state, "The monolingual mindset that has traditionally been preeminent needs to be replaced by a multilingual mindset," for denial of students' first language can be detrimental to their success at learning the content (Shohamy, 2012; Swain, Kirkpatrick, & Cummins, 2011). Recent work on translanguaging (e.g., García, Johnson, & Seltzer, 2016; García & Kleyn, 2016) offers more insights and suggestions in this area.

-design syllabi to explicitly spell out course requirements, thus providing essential guidance through what may be unfamiliar territory (Ferris, 1998). In addition, make sure that assignments are explicitly detailed (Zamel, 2004), and break larger assignments into sub-assignments that students submit for feedback on the way to completing the final version (Koch et al., 1997).

-identify and address academic problems long before the end of the term, so that students have a chance to do something about them. To supplement these efforts, instructors should make sure students know how to manage their time and resources (Hurtado & Kamimura, 2004).

-create an accessible learning environment. Consider applying principles of universal design for learning (Rose & Meyer, 2002), which aim to accommodate a wide range of learner needs by allowing multiple options for students' perception, expression, and comprehension of content. In addition, make classroom language accessible (e.g., by giving definitions of unfamiliar terms, writing clear exam questions, and writing things on the board as well as saying them) (Zamel, 2004).

Perhaps the best advice for instructors teaching ISs is to make classes accessible for all. As Zamel (2004) states,

> …what faculty ought to be doing to enhance the learning of [ESL] students is not a concession, a capitulation, a giving up of standards, for … [w]hat [ESL] students need …is good pedagogy for everyone. Learning how to better address the needs of [ESL] students… helps faculty teach everyone better. (p. 14)

To this end, exploration of techniques that make learning in higher education more accessible for all students at all gradations of English language proficiency makes a great deal of sense.

STEM Instruction in Higher Education

The Pipeline Problem

In the STEM fields of U.S. higher education, there has been just such a push, a push to increase the success of *all* students. This push comes in response to what has been termed the "pipeline problem." Only 40% of students who enter university with an interest in STEM end up persisting long enough to attain a STEM degree (Olson & Riordan, 2012), and most of the doctoral degrees are granted to non-U.S. citizens holding temporary visas (Cech & Kennedy, 2005). Among other concerns, this circumstance strains our country's capacity to meet the

need for scientists, and diminishes the likelihood that the electorate will be capable of making informed decisions about serious dilemmas in public policy (Cech & Kennedy, 2005).

A large part of the problem can be traced to the large, introductory classes that serve as undergraduates' gateway to the STEM disciplines during their first and second years of higher education. Complex content and intense timelines make these courses notoriously difficult, a situation that is not helped by a "laissez-faire attitude among some that although university science classes are tough, those who are really 'cut out for it' will survive to populate the next generation of scientists" (Cech & Kennedy, 2005, p. 1741). Failure rates in these courses are often high, even in selective schools whose admission criteria essentially screen out students with lower likelihood of academic success (Freeman, Haak, & Wenderoth, 2011). Based on available data, Freeman et al. (2011) estimate that one-third of students commonly fail in these courses (Figure 2.1). Beyond the financial and emotional toll that failure in entry-level classes can have on students, failure also frequently leads to students dropping out of their STEM majors and even out of school (Wischusen & Wischusen, 2007). Many of these are underrepresented minority and low-income students (Freeman et al., 2014), and as these students disappear, they take valuable perspectives and creativity with them (Seymour & Hewitt, 1997).

Field	Course	Failure rate	Failure criterion	Reference
Biology	Intro-majors	56%	Average proportion of Ds and Fs on exams	Burrowes, 2003
	Intro-majors	>25%	Course outcome: D, F, or drop	Wischusen and Wischusen, 2007
	Intro-nonmajors	27%	Course outcome: D, F, or drop	Marrs and Chism, 2005
	Biochemistry	85%	F on first exam	Peters, 2005
	Medical Microbiology	30%	Course outcome: D or F	Margulies and Ghent, 2005
Chemistry	Intro-majors	~50%	Course outcome: D, F, or drop	Reardon *et al.*, 2010
	Intro-nonmajors	≥30%	Course outcome ("at most institutions"): fail or drop	Rowe, 1983
Computer science	Intro to programming	33%	Course outcome (international survey): F or drop	Bennedsen and Casperson, 2007
Engineering	Intro to chemical engineering	32%	Course outcome: D, F, or drop	Felder *et al.*, 1998
Mathematics	First-year calculus	42%	Course outcome (U.S. national average): failure	Treisman, 1992
Physics	Intro-majors	33%	Course outcome: D, F, or drop	Marrs and Chism, 2005

Figure 2.1. Failure rates in some gateway STEM courses. From Freeman et al. (2011, p. 176).

The Call of the Council

In response to this circumstance, the President's Council of Advisors on Science and Technology (PCAST) called for an additional one million STEM majors in the U.S. over the next decade, or a 33% increase in the number of STEM bachelor's degrees completed per year (Olson & Riordan, 2012). To accomplish this goal, the council recognized the need for sweeping changes to the way STEM courses are taught, with a shift to more effective, empirically validated teaching practices.

PCAST's call was hardly the first push for improvement in the provision of science instruction in the U.S. Indeed, "For more than 25 years, the scientific community, senior science educators, and public policy leaders have called upon colleges and universities to better prepare their undergraduates for the difficult social, economic, and environmental challenges of the 21st century" (Brewer & Smith, 2011, p. 6). In the field of biology, parallel efforts were thus already underway to improve the outcomes for undergraduate students. The American Association for the Advancement of Science (AAAS) and the National Science Foundation (NSF) joined forces to hold a series of "national conversations" on the future of undergraduate biology education. This culminated in an invitational in July 2009, "at which more than 500 leading biologists, educators, administrators, and students built on the conversations to create a blueprint for real change" (Brewer & Smith, 2011, p. xii). That blueprint took the shape of an influential document called *Vision and change in undergraduate biology education: A call to action*, which stated,

> all biologists, particularly those of us who introduce the life sciences to undergraduates, are facing major challenges. The time has never been more critical to rethink what and how we teach to ensure that the biology we teach engages all students and reflects the biology we practice in the laboratory and in the field. (Brewer & Smith, 2011, p. xiii)

Among the changes it called for were a focus on student-centered learning, including:

> • Engage students as active participants, not passive recipients, in all undergraduate biology courses.
> • Use multiple modes of instruction in addition to the traditional lecture.
> • Ensure that undergraduate biology courses are active, outcome oriented, inquiry driven, and relevant.
> • Facilitate student learning within a cooperative context. (p. xiv)

These techniques could also be referred to as active learning, a set of practices increasingly employed in STEM classrooms. As Freeman et al.'s (2014) meta-analysis of 225 studies, and meta-analyses by others (Ruiz-Primo, Briggs, Iverson, Talbot, & Shepard, 2011; Springer, Stanne, & Donovan, 1999) have found, these techniques offer a promising response to calls for improvement of instruction in the STEM fields in general, and in biology in particular.

Definitions of Active Learning

Many accounts of the origins of active learning point to the seminal work by Bonwell and Eison (1991), though the authors themselves reach back to Dewey, who described learning quite simply as what people do when they study; "an active, personally conducted affair" (1924, p. 390). For their definition of active learning, Bonwell and Eison state that common characteristics are emphases on developing students' skills as opposed to transmitting information, involving students in higher order thinking, and engaging students in activities. Ultimately, they settle on the definition that active learning is anything that "involves students

in doing things and thinking about the things they are doing" (p. 2). Definitions of active learning also often focus on what it is not; namely, "the traditional lecture where students passively receive information from the instructor" (Prince, 2004, p. 223).

In the field of research on biology instruction, Freeman et al. (2014) developed a consensus definition by collecting and coding the definitions provided by over 300 attendees to their seminars on active learning at university biology departments throughout the U.S. and Canada, arriving at "Active learning engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It emphasizes higher-order thinking and often involves group work" (pp. 8413-8414).

Drawing from the above sources and others, Brame (2016) similarly focuses on higher order thinking, but adds reference to constructivism and metacognition:

> …active learning is commonly defined as activities that students do to construct knowledge and understanding. The activities vary but require students to do higher order thinking. Although not always explicitly noted, metacognition—students' thinking about their own learning—is an important element, providing the link between activity and learning.

For the purposes of this dissertation, the definitions of Freeman et al. (2014) and of Brame (2016) constitute what I refer to as active learning – activities that engage students in higher order thinking and knowledge construction, as opposed to listening passively. Active learning often involves interaction with peers, as well as metacognitive reflection.

Meta-Analyses on Active Learning

In a meta-analysis of 225 studies that compared traditional, lecture-oriented sections of courses with those using active learning, Freeman et al. (2014) found that students' exam

scores increased by about 6% in active learning sections. These results, expressed in terms of a weighted, grand mean effect size of 0.47, were almost identical to those of earlier meta-analyses by Ruiz-Primo et al. (2011) and Springer et al. (1999). Furthermore, Freeman et al. (2014) found that students in traditional lecture courses were 1.5 times more likely to fail. As their results held true across all STEM disciplines, and for introductory as well as upper-division courses, they argue that the time has come to move beyond "first generation studies" that compare any kind of active learning with traditional lecture. Effectively, the practice of solely teaching through lecture should be retired, and research should now turn to second generation studies that pit different versions of active learning against one another, based on research indicative of ideal practices.

Common Forms of Active Learning

In the studies described above, a range of activities and class formats are counted as active learning. For the purpose of this dissertation, the focus will be on the kinds of active learning practices employed in the introductory biology class I investigated: discussions, use of clickers/peer instruction, and small group work, all administered in a highly structured course format.

Discussion. The simplest alternative to lecture that is recognized as active learning is the discussion. Bonwell and Eison (1991) describe it as the most common form of active learning, stating

> When the objectives of a course are for students to retain information after the end of the course, to be able to apply knowledge to new situations, to change students' attitudes, to motivate students toward further learning in the

> subject area, or to develop students' problem-solving or thinking skills, …discussion is preferable to lecture. (p. 21)

In her recent review of active learning, Brame (2016) describes discussion as an essential practice, saying "Many faculty members dispense with lecture altogether, turning to discussion to prompt the kinds of thinking needed to build understanding," using discussion techniques in pursuit of various learning goals at various levels of thinking. Included among the items on the active learning scale of the Australasian Survey of Student Engagement (AUSSE) is "Asked questions or contributed to discussions in class or online" (Carr, Palmer, & Hagel, 2015, p. 175). Finally, Freeman et al. (2014, p. 8410) distil the distinction between constructivist (i.e., active learning focused) and exposition-centered (i.e., lecture-based) courses in their study down to a simple question: "In the STEM classroom, should we ask or should we tell?"

Still, the extent to which discussion can truly be considered active learning for each student depends on the extent to which each student is engaged by it. Freeman et al. (2011) describe a form of discussion called "Socratic lecturing" in terms that indicate this variability: "frequent use of questions posed to the class, with answers solicited from students who raised their hands" but which can also include increased participation through think/pair/share, and "asking for a response from students in a particular section of the room, or asking for a response from a student who had not contributed before" (p. 177). Perhaps it is because of this variability with which discussion can be employed that they place Socratic lecturing on the "relatively low structure" side of their continuum (i.e., not terribly distinct from traditional instruction).

Clickers and peer instruction. Clickers, or student response systems, are handheld electronic devices that are increasingly being used in higher education classrooms. These devices allow instructors to collect real-time data on students' comprehension of course content as students "click in" their responses to questions, typically posed in multiple choice format. Instructors can see students' responses instantaneously, and can then choose how to proceed, often by sharing the results and discussing them with the class. A summary of the state of the field on the use of clickers says that clickers "generally cause improved student outcomes such as improved exam scores or passing rates, student comprehension, and learning" and furthermore, "students like clickers" (Caldwell, 2007, p. 13). Much depends on the way clickers are used, of course, from simply spicing up lectures to assessing opinions to managing cooperative learning, but Caldwell states that at worst their effect on exams seems to be positive or benign. Furthermore, when clicker responses are linked to grades, they are associated with increased attendance (Caldwell, 2007) as well as improved performance on exams. This attendance effect holds regardless of whether students get credit simply for participating or for having correct answers (Freeman et al., 2007).

Haak, HilleRisLambers, Pitre, and Freeman (2011) state that "active learning that promotes peer interaction makes students articulate their logic and consider other points of view when solving problems, leading to learning gains" (p. 1215). Clickers can be especially useful for this purpose, through "peer instruction." In peer instruction, instructors disperse concept-checking multiple choice questions throughout their lectures, which students first answer individually via their clickers. When there is substantial disagreement among responses,

the instructor can share the results in the form of a histogram, thus revealing student misconceptions and identifying concepts that students are finding difficult to grasp. Knight and Wood (2005) state that one benefit at this point is that it shows individual students who might otherwise assume they are alone in feeling confused that perhaps as many as half of their classmates are in the same position. The instructor can then have the students discuss and debate their responses with neighbors. In Knight and Wood's observations, as the students engaged with peers to discuss their answers,

> There was often a palpable tension in the classroom until the disagreement was resolved. To exploit this tension, it was important not to reveal the correct choice immediately, but rather to let the students work it out through discussion with the members of their group. (p. 305)

After a short time the students are invited to revote. "Almost inevitably, when a second vote was taken after 3–4 min of discussion, more than 75% of the class chose the correct answer" (Knight & Wood, 2005, p. 305). Smith et al. (2009) find such a result is common, as "Most instructors report that the percentage of correct answers, as well as students' confidence in their answers, almost always increases after peer discussion" (p. 122). The instructor then shares these results with the class, discussing the correct answer and the reasoning behind it.

Research on peer instruction reveals numerous benefits. Though it might be assumed that the increase in correct answers comes from the students who know the answer sharing their knowledge with their peers, Smith et al. (2009) find that even for "naïve" groups in which neither member originally had the right answer, the trend toward a correct revote holds. Apparently simply engaging with the topics and seeking to resolve the "tension" is enough to

foster learning. Caldwell (2007, p. 18) adds that "The strength of peer instruction is the interaction it fosters between students," for their similarity in age, language, and experience make them better able to address one another's confusions than the instructor. Plus, when students have to put their (mis)conceptions into language to a peer, the deficiencies in reasoning become apparent to them (Beatty, Gerace, Leonard, & Dufresne, 2008). Added benefits of peer instruction are that it decreases attrition and leads to better conceptual learning than traditional instruction, in various contexts of higher education, and that the gains for less prepared students bring them up so far as to be equivalent to the level of students in traditional classrooms who started with more background knowledge (Lasry, Mazur, & Watkins, 2007).

Small groups and collaborative work. "What students learn is greatly influenced by how they learn, and many students learn best through active, collaborative, small-group work inside and outside the classroom" declare Springer et al. (1999, p. 22) in the introduction to their seminal meta-analysis revealing the positive effects of small group work in comparison to traditional lectures. Benefits include increases in academic achievement, positive regard for learning, and persistence in the STEM disciplines. In addition, collaboration in STEM courses can allow students to experience the same kinds of interactions that scientists engage in throughout their inquiries, and it can diminish the competitiveness in the sciences that turns women and underrepresented minorities away (Springer et al., 1999).

The research is similarly clear regarding the benefits of small group work undertaken in a cooperative fashion. For instance, Smith, Sheppard, Johnson, and Johnson's (2005) meta-

analysis of 305 studies on cooperative learning in college and adult education settings found benefits in students' knowledge acquisition, retention, accuracy, and higher-level reasoning. In addition, they found that it fosters persistence by facilitating the development of students' social networks, as it promotes greater liking among students than competition or independent work. This finding was found to hold regardless of students' ethnic, cultural, or language background. In addition, this cooperative learning can provide occasions for international and domestic students to engage with one another, which ought to be a critical concern for any institution that aims to actualize the potential of the international classroom (Zhao et al., 2005).

Informal cooperative learning can take place within lectures or in separate discussion sections, in which ad hoc groups discuss class content together and "ensure that misconceptions, incorrect understanding, and gaps in understanding are identified and corrected, and that learning experiences are personalized" (Smith et al., 2005, p. 93). One way of ensuring that students engage at this level is the collaborative quiz, which involves students taking a quiz as a group, with a shared score for all. Research shows that administering quizzes in this format leads to improved scores (Eaton, 2009; Rao, Collins, & DiCarlo, 2002), as well as increased retention of content learning over time (Cortright, Collins, Rodenbaugh, & DiCarlo, 2003).

High structure. In addition to the kinds of active learning activities selected, another important factor is the way in which they are implemented, particularly in terms of the amount of structure provided. Whereas traditional classes are often "low structure" in the sense that students learn from lectures and are evaluated via high-stakes assessments (e.g., two or three

midterms and a comprehensive final exam), highly structured courses develop and reinforce the content and skill learning over the course of a term, with daily and weekly active-learning exercises designed "with the goal of providing constant practice with the analytical skills required to do well on exams" (Freeman et al., 2011, p. 176). Highly structured courses may use various means to require students to prepare for class, and they may use student response systems (e.g., clickers) to compel participation in class sessions focused entirely on active-learning exercises. An additional part of the routine might involve a weekly low-risk assessment, such as a practice exam (Haak et al., 2011, p. 1214).

Research shows that when compared with students in low structure courses, all students in highly structured introductory biology classes experience improved performance, and that this structure is of particular benefit to those students most at risk of failing the course (Freeman et al., 2007; Haak et al., 2011). In one study that compared multiple iterations of a course ranging from relatively low to moderate to high structure, the exam score gains for students increased in correspondence with the increase in structure, even though the higher structure iteration had a larger class size and a decrease in the ratio of TAs to students (Haak et al., 2011). Deeper analysis revealed that the learning gains were real in the sense that the exam questions for the higher structure courses had also increased in challenge, with a greater emphasis on higher levels of Bloom's Taxonomy. In another study, Freeman et al. (2011) found that increasing course structure reduced failure rates in biology from 18.2 to 6.3%.

One component that can go hand-in-hand with high structure course design is deliberate student reflection on the foundations behind this design, such that students can

understand the rationale and appreciate the benefit it is having on their own learning. In other words, this thinking about learning, or metacognition, may complement and reinforce the benefits of high structure, leading to more effective participation in active learning. As Tanner (2012) notes:

> One possible difference in the effectiveness of active-learning pedagogies in the hands of different instructors may lie in the extent to which these instructors consider student metacognition when they implement active-learning strategies… explicit attention to integrating metacognition into undergraduate biology classrooms could help keep a focus on the learning part of active learning. (p. 119)

Potential Benefits and Drawbacks of Active Learning for ISs

In addition to all of the benefits described above, research shows that active learning is effective at supporting diverse populations that are typically underrepresented in STEM disciplines, such as underrepresented minorities and first-generation students (Haak et al., 2011). Haak et al. add that a further benefit of these activities is that they have a cost advantage over alternative interventions such as supplementary tutoring, which can be expensive and therefore unfeasible to maintain.

It is reasonable to imagine that active learning might be valuable to ISs as well, but data on the impact of active learning on ISs are not presently available. Though ISs make an increasing portion of these classes, it seems that they are largely invisible. In most studies this population is not mentioned – they presumably disappear demographically into the "other" category. Even those studies that do collect information on ISs may ultimately discard it (e.g., Freeman et al.'s, 2007, decision to leave TOEFL scores out of their study). An excerpt from the

Vision and Change document described above is similarly telling (Brewer & Smith, 2011). In a paragraph dedicated to demonstrating the vast diversity within current undergraduate biology classrooms, ISs are nowhere to be found:

> Undergraduates are more diverse than ever, coming from a variety of social, economic, and ethnic backgrounds. They enter institutions of higher education from a variety of entry points: directly from high school, as transfer students from community colleges, or as students starting their college career after military service or other postsecondary life experiences. Some nontraditional students return to college to complete a college education started years earlier or to explore new educational goals. Transfer patterns are equally diverse. For example, faculty at four-year institutions often interact with transfer students from community colleges, while faculty at community colleges may work with students from four-year institutions completing required coursework at their campus. Although the educational and career paths these students follow are as diverse as the students themselves, all students should graduate with a basic level of biological literacy in order to participate as informed citizens and thrive in the modern world. (p. 4)

A further search through the 100-page document reveals that this omission is complete – nowhere do the words "international student," "English," or "ESL" appear.

In short, data on ISs and their ways of engaging in current innovations in biology classes is lacking. Though the research evidence in favor of active learning is large and persuasive, the value of these practices for this population is largely unknown. Insofar as active learning makes use of collaborative learning, and parallels the student-centered pedagogy that has become the norm in modern ESL/EFL instruction, we may expect it to be ideally suited to ISs, and we may even expect those ISs who have experienced such student-centered language instruction to be able to draw from these prior learning experiences to facilitate their success (Muñoz, 2004). However, there are reasons to believe that the benefits of such pedagogical approaches may be

dependent on cultural background (see, e.g., Bowers, 2005; Zhao et al., 2005). Students from traditional educational backgrounds may prefer teacher-centered approaches to education (e.g., Hu, 2002; Jackson, 2002; Li, 1984), and ISs may fear loss of face during exchanges with classmates (Jackson, 2002), perhaps particularly with domestic classmates who may lack the patience and understanding necessary to make the peer interaction of active learning effective. In that case, compelling students to interact could be counterproductive, as it may lead ISs to withdraw from face-to-face education, eschewing direct interaction with peers or instructors in favor of technology-based alternatives (Zhao et al., 2005). On the other hand, these concerns about ISs may be outdated (Shi, 2006), and at the least, ISs may find such activities as learning in small groups a preferable alternative to speaking up in front of the class (Jackson, 2002). In short, classroom-based research is necessary to identify just how ISs engage with such educational innovations and to what extent such students may be advantaged or disadvantaged by their use in content courses in higher education.

Chapter Three: Conceptual Framework

An ideal approach to supporting ISs in higher education might be one similar to the model advocated in Snow, Met, and Genesee's (1989) conceptual framework (Figure 3.1). In this model, language instructors and content instructors jointly construct their curricula by drawing from their respective areas of expertise to attend to IS content learners' development, focusing on both content-specific, "obligatory" language learning as well as "content compatible language" derived from a language-centered syllabus, language that is not explicitly necessary for the content learning but which is matched to the obligatory language in some fashion, and which can thus be included for the sake of developing students' language abilities. Snow et al. envision their framework as something applicable to various settings of primary and secondary education, and they provide examples of its application to four different contexts, including the immersion context, which may parallel an ideal program of higher education in which "the content teacher and the language teacher are one and the same" (p. 211).

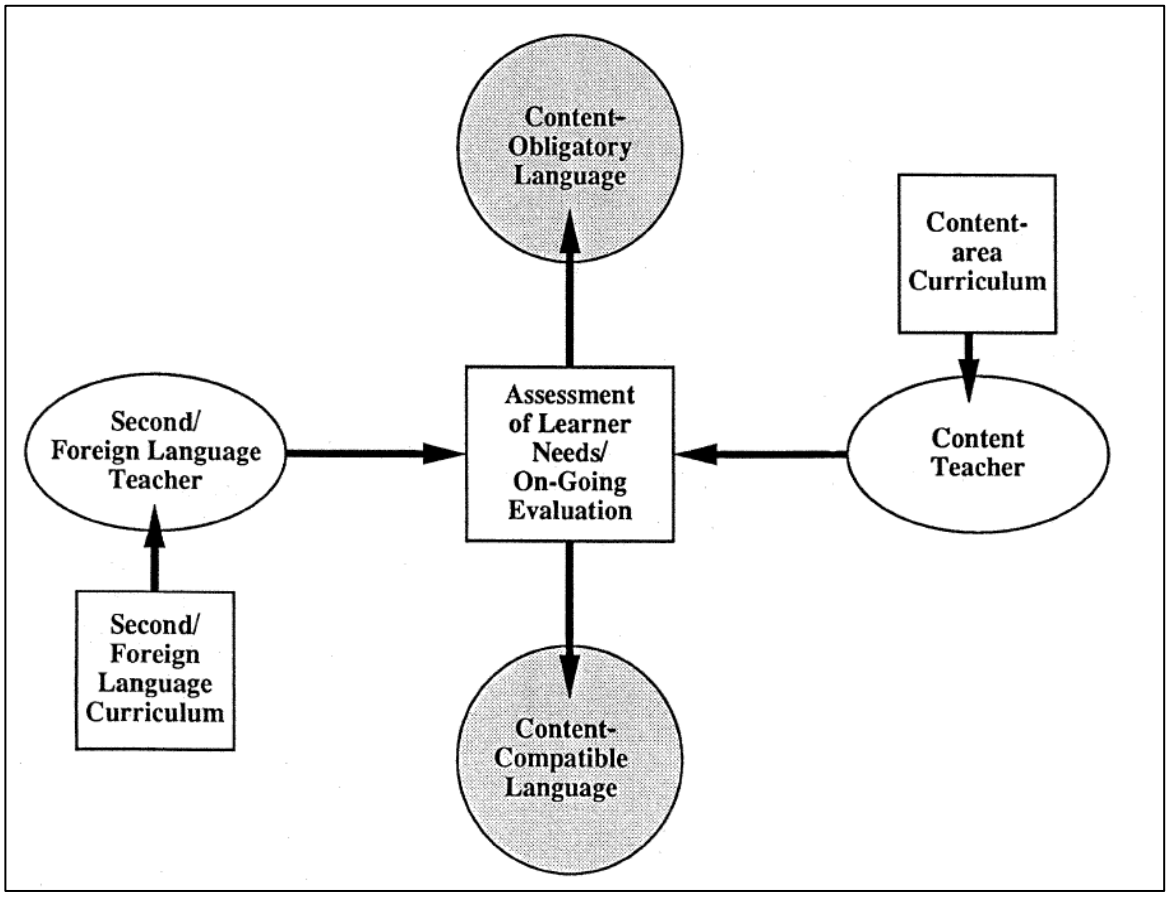


Figure 3.1. Snow, Met, and Genesee's conceptual framework for integrating language and content instruction (1989, p. 205).

As Snow et al. present their four contexts, they implicitly recognize that the teaching of language and content exists on a continuum, not unlike the one depicted in van Lier's (2005) "Scale of language and content" (Figure 3.2). At the left extreme of this scale we find courses where language is the focus, in which content is primarily used as a means of exposure to language, perhaps in a theme-based fashion. At the opposite side the focus is primarily on content, though lecturers are presumably at least aware that students may face language-related challenges due to their status as ISs, as would be the case in EMI contexts. Mainstream U.S. contexts of higher education sit even further to the right extreme, in which content

instructors may scarcely recognize the presence of ISs, and thus may not realize that any of their students have needs associated with the use of English as an L2 at all.

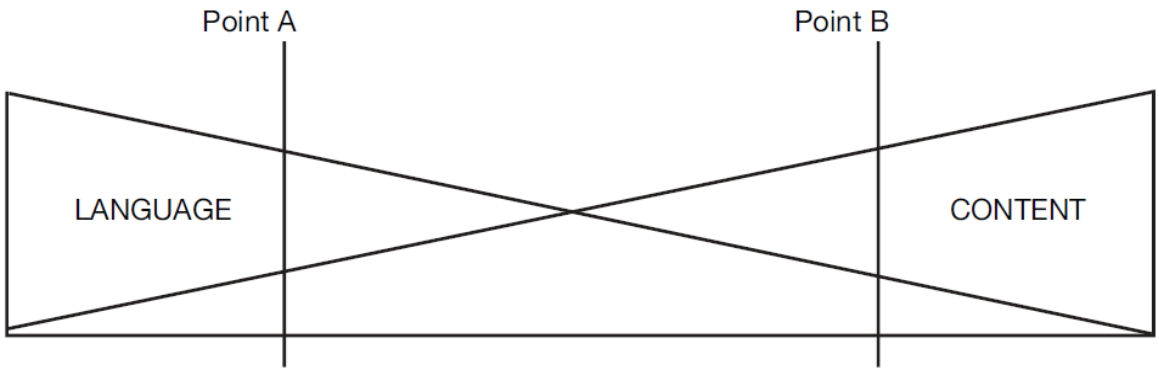


Figure 3.2. van Lier's (2005) scale of language and content.

To represent this latter U.S. context in which teachers assume all students to share the highest levels of language proficiency and thus require little or no language support, we might consider Snow et al.'s conceptual framework as a means of identifying gaps in the education of ISs, with the box for "Second/Foreign Language Curriculum" and the oval for "Second/Foreign Language Teacher" removed to denote the absence of this contribution, and with the resulting circle for "Content-Compatible Language" removed as well. In this circumstance, the focus is solely on students' content learning, and there is no focus on language beyond that which is explicitly called for in the comprehension of the content. As a result, opportunities for language learning neither noticed nor considered by the instructor, and students who require language support must find it outside the content classroom.

However, in the case of recent trends in STEM instruction in higher education as described in chapter two, the content teacher's manner of delivering the content curriculum in relation to learners' needs merits further analysis. In this instance, though the content instructor does not make explicit accommodations to the needs of L2 users of English in particular, the instructor focuses instead on promoting all students' success and persistence. Naturally, this broad pursuit may incorporate support that also matches the needs of ISs who may struggle to succeed due to language-related challenges. To ascertain the extent to which these STEM approaches are compatible with ISs' needs, we must further examine what the STEM instructional approaches entail, and how they are received by ISs.

As Figure 3.3 demonstrates, many of the practices of the modern STEM classroom seem ideally suited to the needs of ISs, such as the provision of various forms of support (e.g., visual support, vocabulary explanations, reading guides, peer tutoring, and more). In addition, the setting of explicit expectations, as outlined in the syllabus and described in class, is well-suited to the needs of ISs who may not have prior exposure to U.S. classroom norms and may thus otherwise fail to recognize crucial aspects of their educational setting.

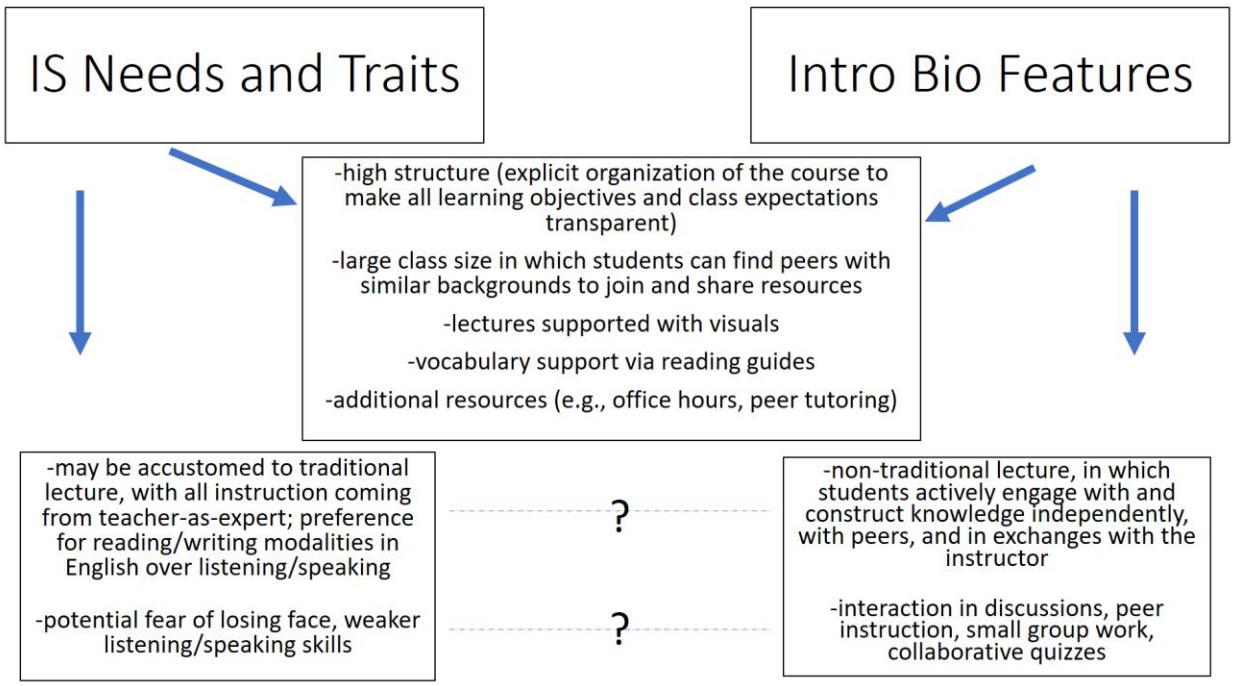


Figure 3.3. Convergence and divergence of ISs' needs with the provisions of introductory biology instruction.

However, two aspects of the STEM classroom in particular stand out as posing potential challenges for these students. The first is a global concern, that these students may be most accustomed to learning via a traditional, "banking" model of education in which the teacher-as-expert showers knowledge upon the students in a unidirectional fashion, with students rarely invited to participate other than to ask or answer questions on occasion. Current trends in STEM instruction make an intentional and dramatic departure from this model, favoring interaction of all kinds, as well as students' construction of knowledge for themselves. Nested within this departure is a more specific concern for ISs, the heavy use of collaborative learning. Though these activities offer students the opportunity to test their understanding and learn from one another, time dedicated to these endeavors may be wasted on students who choose

not to engage with their peers, or who engage in a superficial fashion, perhaps out of a fear of losing face or due to a reluctance to appear less than knowledgeable, as may be the case for those who tend to avoid occasions in which they are at risk of demonstrating a lack of ability, known as a performance-avoid orientation toward achievement goals (Dweck & Leggett, 1988). In addition, students who believe that only traditional forms of lecture that follow the "banking" model are legitimate may question the efficacy of the instructor, and may regard the entire class a waste of time, dedicated to fun and games as opposed to more serious pursuits of knowledge.

This dissertation aims to investigate these areas of convergence and divergence between STEM instructional components and ISs' needs and preferences, ascertaining the extent to which these innovative educational approaches may be suited to ISs, despite the absence of the kinds of language support advocated by more integrated models of content and language instruction.

Chapter Four: Methods

In this chapter I begin with a description of the setting and the data I collected in this classroom-based study. Following a discussion of the mixed methods design, I will describe the means I used for identifying the sample of L2 English-using international students (ISs) and the sample of English-dominant students (EDSs) from the larger data set. I subsequently describe the methods of analysis I used as I sought responses to the first two research questions, which call for statistical analysis of numerical data. I then turn to the more qualitatively oriented research questions, and I describe the ways I recruited and selected the interview participants, as well as the methods of analysis I used to interpret interview and open-ended survey data. I close each of these sections with consideration of assumptions and limitations of the methods of analysis used.

Setting

At a large research-intensive public university in California, thousands of incoming first-year students enroll in introductory biology courses in their first term. This study examines one such course, with a total of 859 students distributed across two sections taught by the same instructor. Most (95%) were in their first year, and approximately 6% were international students. The majority of these international students came from China. These students arguably faced many of the greatest academic challenges of studying content through a foreign language, as they joined hundreds of students in their first large lecture course, in a subject that involved complex concepts, copious amounts of new, technical vocabulary, and a heavy workload.

The course was taught by an "instructor with employment secured," a position that offers a form of tenure that is based not on research publications, but instead on excellence in teaching and service, contributions to the field's discipline or pedagogy, and continual professional development. Face-to-face instruction was provided by this instructor in three 50-minute "lectures" per week, which took place in a large lecture hall attended by over 400 students per section. Supplementary but mandatory 50-minute discussion sections facilitated by one of the ten graduate student teaching assistants (TAs) were offered once a week, with approximately 30 students in each. Students also had access to TA and instructor office hours, peer tutoring, and non-face-to-face resources such as Piazza, an online bulletin board for posting questions.

Lectures

After a first day focused on logistics and broad concerns related to being a successful student in the class ("lesson zero"), each of the subsequent classes opened with a predictable routine. In the instructor's words, the students were expected to

> come to class prepared by doing a pre-class reading guide that is optional that I made to help them read through the textbook. And also they do a pre-class activity on our online system *Mastering Biology*. And then when they get to class, … we can hit the ground running.

The instructor would begin class with a title slide and announcements, sometimes as separate slides, sometimes merged into one. In the early days this would be an occasion for him to remind the students of their responsibilities, as well as resources available to them (Figure 4.1). In later days the instructor might talk about upcoming assignments or exams, as well as

other class business such as adjustments to the office hour schedule. In his opening he would also often work in a casual comment or two in relation to popular television programs, sports, or the news, and he would introduce the topic of the day's lesson.

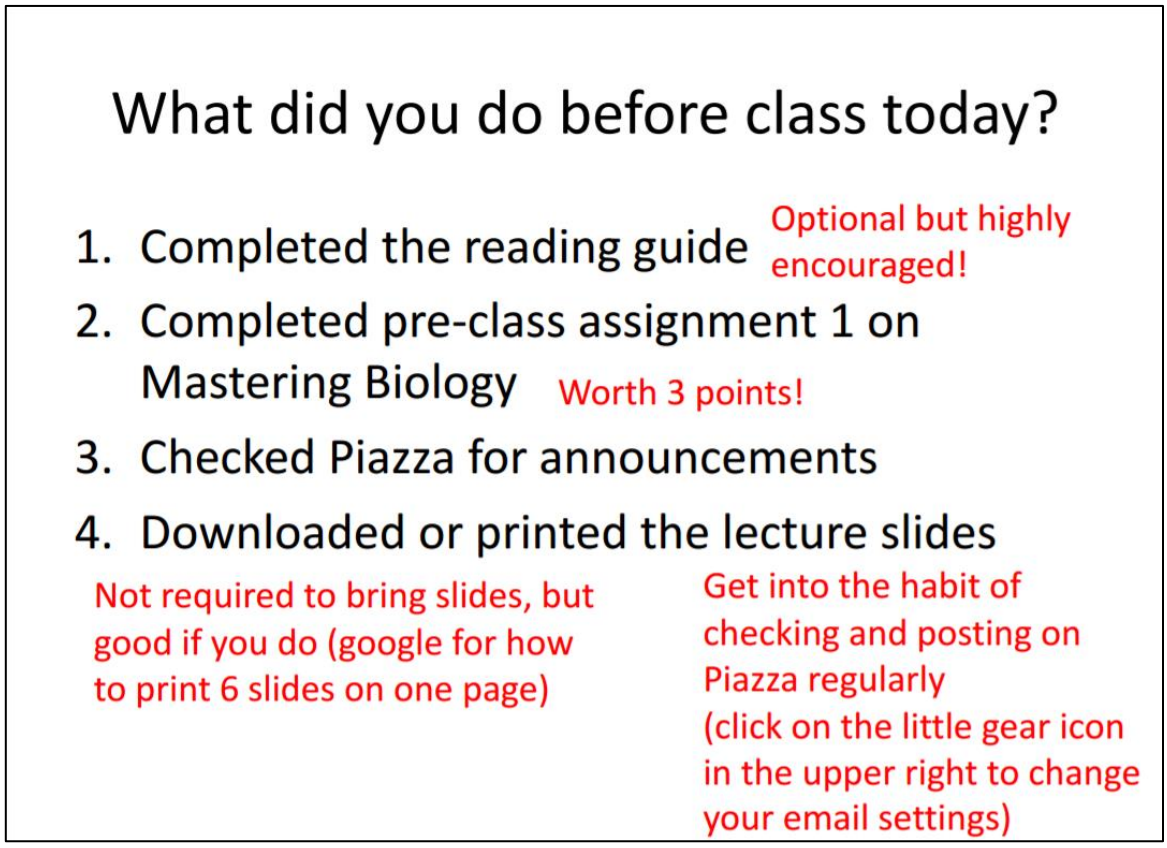


Figure 4.1. Student responsibilities and resources. Slide from lesson one.

Next came a slide with numbered learning objectives (e.g., 3.1 representing the first objective of lesson 3, 3.2 for the second objective, and so on). The objectives were stated in terms of measurable activities that the students would be able to do, such as "apply," "design," and "analyze" (Figure 4.2). A subsequent slide provided key terms, with terms that were not found in the book marked in red (Figure 4.3). Finally, the last side of the opening routine highlighted the work of a member of the biology department, with descriptions of the

professor's research, labs, and course offerings, which the instructor described as partly an attempt to personalize and personify the research.

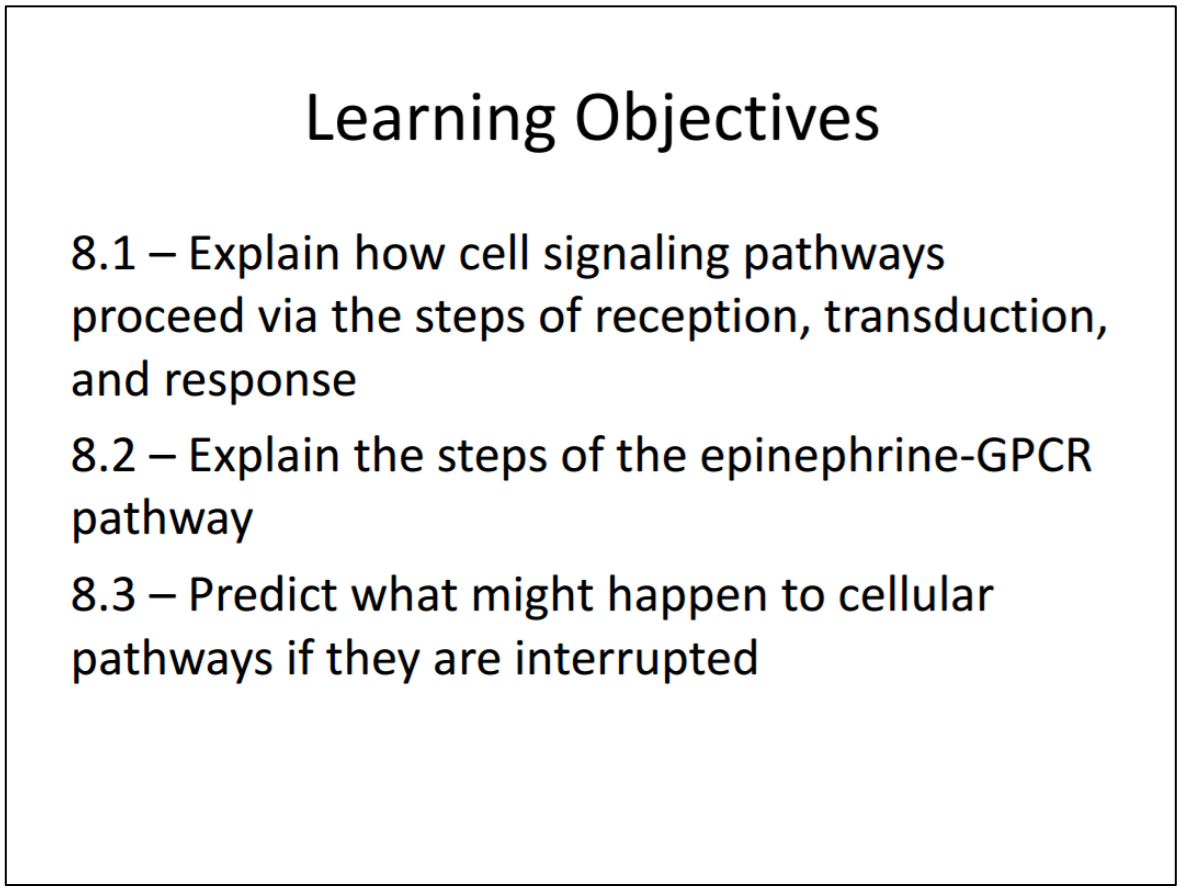


Figure 4.2 Learning objectives. Slide from lesson eight.

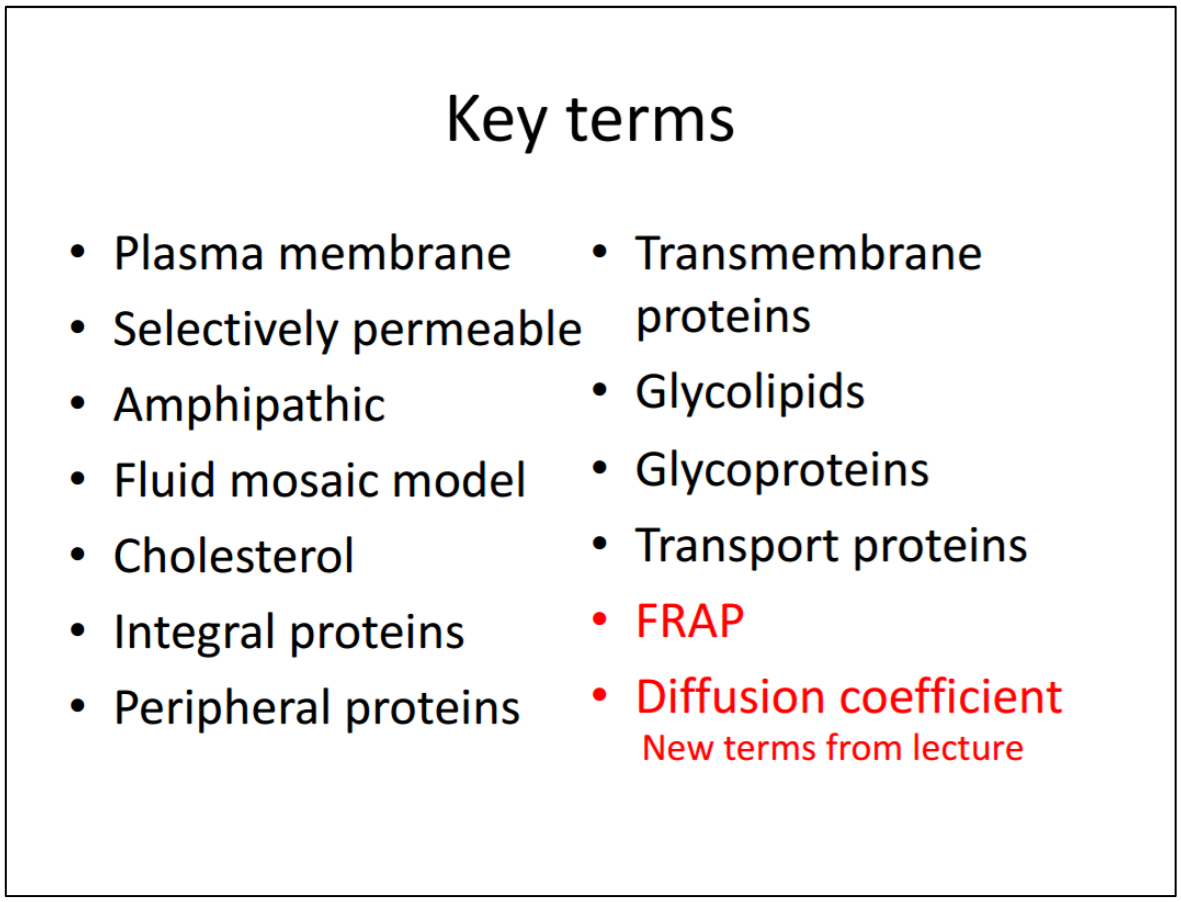


Figure 4.3 Key terms. Slide from lesson five, with terms not found in the book marked in red.

The instructor would then launch into the actual content of the day, which was addressed partly through instructor-driven content supported by slides and short videos, at times punctuated by other kinds of demonstrations and interactions, such as the "meiosis finger dance" in which students used their hands to help them visualize phases. Interpersonal interactions were a defining feature of the lessons, joined with a focus on higher order thinking and real-world connections, as the instructor shared during an interview:

> We do a lot of clicker questions to get them involved and assess what they know, and we do a lot of interactions between the students to gauge what they're learning and help each other out, and also apply what they've learned. So, we're not going to just do the basics of stuff in lecture (what is starch, what

> is glycogen), but either give them a question to assess the basic concepts that they've read about already or put it in new contexts. I also really enjoy adding in actual data from scientific literature to show them implications of what they are learning about, and show them what science is really like, and also show them real world implications of relevance to medicine, and health, and disease, ecology, whatever else that might tie in the topics to make it more come to life, make them care about it more.

The instructor added that he tried to "go with best practices based on published research" regarding use of the clickers and peer instruction (Smith et al., 2009). He would pose a question and monitor the responses "on the podium at the base," and

> if I get about 70% or higher I tend to just take it you know and I usually show them the response and either ask for an explanation or I give it myself and move on. If time is an issue, I'll opt for that more as well, just to kind of move through it. But …if I notice them, not answering it, the majority, correct, I'll say "Ok now talk to each other about it" then repoll. And usually, not every time, but usually they shift toward the right answer because they help each other out. And there's a couple of articles published on what's going on during that peer interaction – it's not just the smart students telling the students that were wrong what the right answer is, they actually seem to have meaningful discussions.

These occasions for students to turn and talk with their neighbors for one minute or less were frequent and not always tied to clicker use. The corresponding slides often provided students with meta information about these questions and activities, with numbered circles with check marks denoting corresponding learning objectives, and numbered triangles marking the associated levels on Bloom's taxonomy (Figure 4.4). As the instructor explained on the second day of class,

> So, what you are seeing here in the corner are these check marks with numbers? So these are the learning objectives: 1.1, 1.2, 1.3, so every time you see these on the slides, that's going to represent an example of a question that addresses that learning objective. So I'm trying to get you to understand how I

assess the different learning objectives? So here's one [1.1] for applying the scientific method to real life, here's one [1.3] for analyzing bar graph data. Also in the corner you see a triangle with a two. These are the Bloom's levels we talked about on day one. Bloom's level one – lower level thinking, Bloom's level two – application and analysis, Bloom's level three – evaluating/creating. So this is an example of a level two type question which you get in the majority of the exams are questions like this. So both of these symbols are going to help orient you to what we're doing as we're going in class.

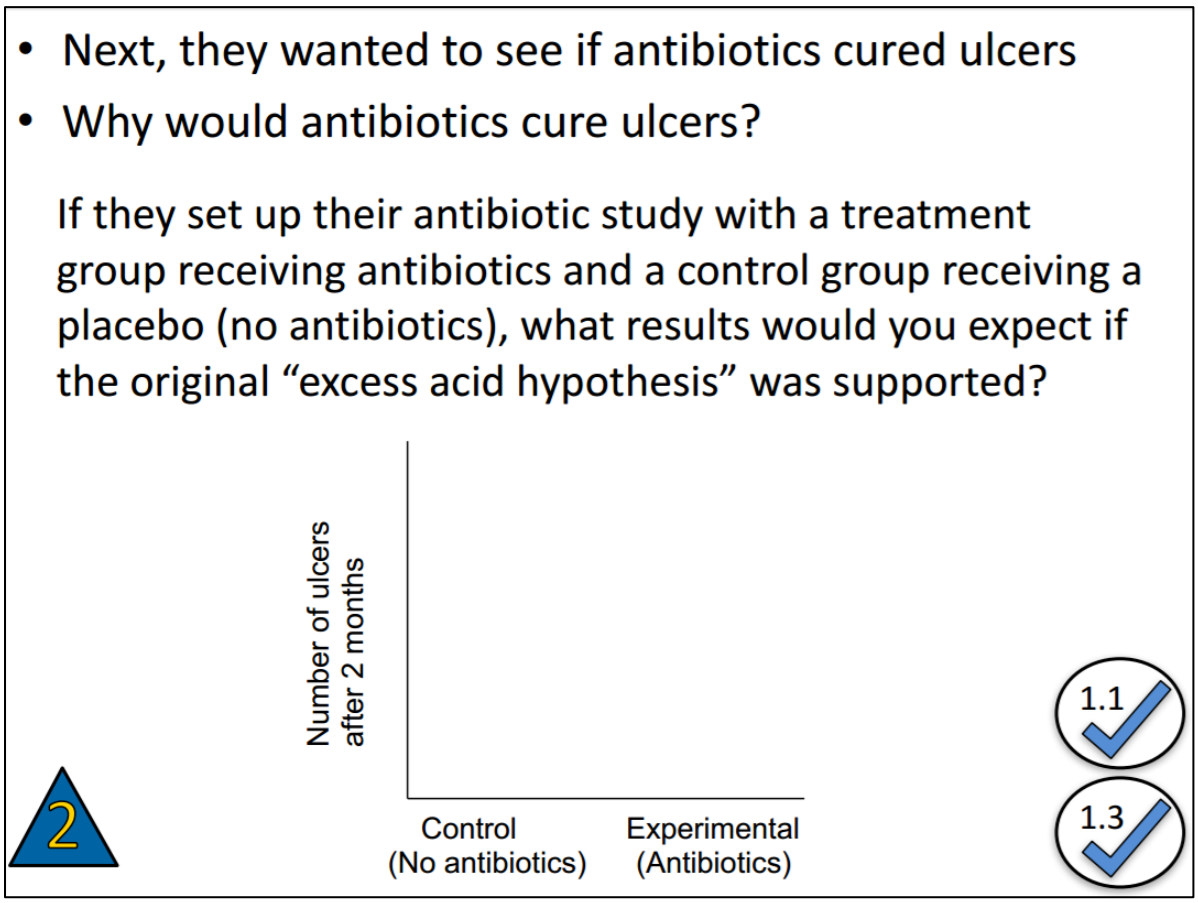


Figure 4.4. Slide with symbols for corresponding learning objectives and levels of Bloom's Taxonomy. From lesson 1. Triangle denotes the second of three levels of Bloom's Taxonomy ("application and analysis"). Circles denote the corresponding learning objectives of the day ("1.1 – Apply the scientific method to real-life situations," "1.3 – Analyze data and draw conclusions from bar graphs").

Other activities in the class included the use of Kahoot!, a more game-like alternative to clickers in which the fastest, most accurate participants were recognized publicly, and whole-

class discussions, which were driven by questions that came from the instructor or from students. The instructor would walk up and down the aisles during these and most other parts of the lesson, interacting with students in all corners of the hall.

Discussion Sections

The TAs' amounts of prior teaching experience ranged from just a few months to several years. As preparation for these sessions, these graduate students attended 12 hours of mandatory institution-wide TA training in the fall of their first year, and the instructor held his own two-hour introductory TA training meeting at the start of the quarter, followed by weekly meetings to discuss issues TAs were having in their classes and talk about how to teach, do active learning, and write tests.

Students' attendance at the TAs' weekly 50-minute discussion sections was mandatory, with approximately 30 students assigned to each section. TAs typically dedicated the first minutes as a time for students to ask questions, then they gave out worksheets for the students to complete in groups. This was then followed by class discussion of the answers. Occasionally TAs did not follow this pattern precisely, instead facilitating other kinds of activities such as team quiz games or having students demonstrate comprehension by drawing diagrams at the board. At the end of the session, students completed a quiz independently, then joined their fellow group members to compare answers and reach consensus on a single copy of the quiz that they would submit for their shared grade.

Assignments and Grades

Outside of the lectures and discussion sections, students were required to complete readings, online assignments, and weekly quizzes on their own time. Final grades were determined primarily by their exam scores (two midterms worth 20% each and a final exam worth 40%), with homework/online quizzes worth 12% and their participation in lectures and discussion sections accounting for 8%. Assignment, exam, and participation point values added up to 1,000 points, and these point values were later converted to letter grades. Students received As for scores over 795, Bs for scores over 695, Cs for scores over 595, Ds for scores over 495, and Fs for the remainder.

Selection of the Course for Study

I identified this course for study during a university "open classroom week" in which 28 instructors volunteered to open their classroom and lecture hall doors to visitors. I attended as many of the classes as I could, making judicious decisions when multiple courses were offered at the same time. In all I attended 17 of the classes, casting a wide net to see what teaching practices I would encounter in these university classrooms, and to see which courses seemed to be populated by the most ISs. I learned that many of the instructors in the STEM disciplines were using engaging pedagogy that placed a premium on opportunities for students to think independently, work through problems, and exchange ideas with their peers. After each class I introduced myself and shared my research interests, and several instructors expressed their willingness to have me return to study their courses in the future.

I ultimately decided to focus on the fall introductory biology class because of the large number of first-year ISs who would be having some of their first experiences of content

learning in U.S. higher education, because the instructor was supportive of my interest in conducting the study, and because my first observation of his class gave me ample evidence that he had facility with a variety of engaging teaching techniques that may or may not prove helpful for ISs, including the use of clickers, open discussion, and collaborative learning.

Data

Primary data sources for this study included: (a) demographic data from a preliminary survey administered early in the term (58 items, n=792); (b) post-course survey responses (95 items, n = 757); (c) Biology course grades for all students; (d) institutional data for all students, collected as part of the admissions process; (e) more than three and a half hours of interviews with four ISs who speak Chinese as a first language; (f) approximately two and a half hours of interviews and informational conversations with the instructor, distributed over multiple sessions; and (g) over four hours of interviews with the ten TAs, either individually or in pairs. Secondary sources of data used for additional contextual information included: (a) field notes from over 48 of the 52 hours of lecture that were provided across the two sections, 21 hours of discussion sections, and three weekly TA planning meetings; and (b) course resources and documents. I describe each of these sources of data in greater detail below and in the later section on constructivist research design.

Relevant data from the preliminary survey consisted primarily of demographic information related to students' language backgrounds, whereas the post-course survey included items focused on self-reports of students' in-class behaviors, and their opinions regarding the importance of various components of the course. Students were given modest

extra credit for completing these surveys, and the response rates were 92% and 88%, respectively. Institutional data included demographic information such as scores from SAT aptitude tests for college admissions and TOEFL/IELTS tests of English language ability, high school information, first-generation college student status, and race/ethnicity.

As this is a classroom-based study, most of the data were drawn from the existing practices of this course, and I had no influence over the wording of any items on these data collection instruments. The exception was the post-course survey, on which the instructor permitted me to insert a few items targeted primarily at ISs, focusing on such things as relationships between their language and content learning, and reports of how they engaged in various active learning practices (see Appendix A for post-course survey). These items were informed by the data I had collected in my field notes and interviews, and I worded these questions in a fashion that aligned with the instructor's existing questions, in order to make for ease of comprehension and also to allow for comparison of data across various items. Most of these additional questions were targeted to the ISs in the class.

I gathered field notes from both sections of each day's lectures (i.e., I attended lecture A from 12-12:50 pm and remained for lecture B from 1-1:50 pm). These notes were used primarily to provide context for my interpretation of survey and interview data. They include copy/pasted screen captures of the day's slides (made available to all students in advance via the class website), and a running record of what transpired, including what the instructor said and did, how he set up active learning activities, and how he interacted with the students. As I acquired a sense of who the ISs were, I expanded my focus to include more notes on their

behaviors, attending to how ISs engaged in the various instructional techniques employed. Though the content of the second lecture was identical to that of the first, staying in class for the second iteration allowed me more opportunities to see how the students were engaging with the active learning activities. Within 24 hours of each class observation, I revisited these notes, revising and enhancing them as much as possible from memory. Once the notes had been finalized, I engaged in first-cycle coding (Saldaña, 2012) and added a prefatory memo on the contents of the notes, highlighting components of particular interest.

With regard to the 294 hours of TA discussion sections offered over the course of the term, I sampled purposefully (Patton, 2015) to achieve both breadth and depth of data collection. To get a sense of the overall continuity of a discussion section and what students' experiences may have been like, I selected one TA to observe for all ten weeks. In addition, for four other TAs who either demonstrated teaching practices of interest or whose sections were attended by ISs, I attended 3-4 times. For the remaining five TAs, I visited discussion sections once each in order to ascertain the extent to which teaching practices might vary from TA to TA, and to provide context for my interviews with the TAs and ISs. In addition, I sat in on all or part of three of the TAs' weekly planning meetings with the instructor, in which they discussed pedagogy and sorted out logistics for assignments and exams. I revised these notes within 24 hours of the observations, following the same procedures as I did for my lecture notes.

Further data in the form of the course website, podcasts of the lectures, reading guides, lecture PowerPoints, and the syllabus provide additional contextual information as well as evidence of the teaching techniques and student support provided.

I recruited student interview participants via class announcements, informal conversations after class, and snowball sampling, which involved asking students who agreed to interviews to nominate other ISs for participation (Hatch, 2002; Lodico, Spaulding, & Voegtle, 2010). All interviews were semi-structured, organized around a set of predetermined topics informed by research literature on ISs in higher education, as well as my field notes (see Appendix B for student interview protocols). Common topics included active learning activities and challenges faced by ISs. The four students who agreed to participate in interviews were all speakers of Chinese, with two females and one male coming from mainland China and one male from Taiwan (see below for more detailed profiles of these interviewees).

Mixed Methods Research Design

To analyze this mix of numerical and verbal data, I used a convergent parallel mixed methods design (Creswell, 2014), in which I merged quantitative and qualitative data with the aim of facilitating a thorough and multi-dimensional representation of the key characteristics of this setting. In the subsequent analysis, I combined analytical approaches typical to quantitative data with those typically used in the interpretive tradition, which might be expected to help "correct for biases that each approach suffers from separately" (Lin, 1998, p. 164). More specifically, I used t-tests and multiple linear regression analysis on the survey and institutional data to answer questions about broad trends regarding ISs' participation in a large introductory content course taught through active learning, and I sought deeper insights through constructivist approaches to analysis of open-ended survey responses, interviews, field notes, and other data. These qualitative and quantitative data were collected at overlapping times,

with classroom observation field notes informing interview protocols and survey question design, and with interview responses also contributing to the survey design.

In the subsequent sections I describe the approaches I took to answering the first two research questions, which revealed important descriptive information about the ISs in this course. I then detail my approaches to analyzing the open-ended data as I sought answers to my remaining research questions.

Quantitative Research Design

The preliminary parts of the study required a quantitative research design to obtain answers to the first two research questions:

RQ1: In comparison to their English-dominant domestic peers, how well do ISs perform in a biology course taught through the use of active learning?

RQ2: For these ISs, how are factors such as English language proficiency, academic ability, and receptiveness to active learning associated with their performance in the course?

Before I could begin to find answers to these questions, I needed to identify the ISs in my data set, and then construct a contrasting English-dominant sample of students who would be expected to face no content learning challenges related to the use of English as an L2.

Identifying ISs. The identification of international students who are L2 users of English is no simple matter, as the continuum of language learning extends from first contact with a language to becoming what might be considered fully bilingual, with infinite gradations in between. Indeed, a compelling case can be made that a more accurate description of most

people's language capacities is that they sit somewhere on a continuum of bilingualism (Kroll & Bialystok, 2013).

To maintain a consistent sample of students across my statistical analysis for the first two research questions, I first narrowed my whole-class sample to those students who had taken the post-course survey and for whom essential institutional data were available (i.e., gender, first-generation status, and SAT scores). Most of the students (85%) met these criteria, or 731 out of 859. I also removed students who were not in their first year of study, in order to focus on students who were likely the newest to actively learning content in a U.S. higher education setting, thus bringing the whole-class sample down to 698.

To identify ISs within this subsample of students, I used institutional data as well as responses on the two surveys. Institutional data included: (a) TOEFL/IELTS scores; (b) visa status (i.e., identifying students as "international students" or not); (c) location of high school attended (e.g., "Unknown People's Republic of China"); (d) open-ended self-reports of language learned first; and (e) placement in foundational/introductory English reading or writing classes during their first term. Items from the survey administered by the instructor early in the term included: (a) language spoken at home (e.g., with parents); and (b) whether English was their first language, and the post-course survey contained the question "Was English the primary language spoken at home when you grew up?"

The university policy for screening students for English language proficiency suggested an ecologically valid starting point for identifying ISs who came to the U.S. recently: all students who have not attended high school for more than three years in the U.S., and who come from

countries where English is not the language of instruction, are required to demonstrate their proficiency, typically by submitting TOEFL/IELTS scores. The two sets of data that were thus most essential to identifying these ISs were TOEFL/IELTS scores (i.e., whether the student had been required to submit these test scores, and if so, how high the scores were) and visa status (i.e., whether the institutional data labeled the student as an "international student" or not).

Of the 47 students who submitted TOEFL/IELTS scores, 39 were first-year students who were not missing institutional data or post-course surveys. TOEFL/IELTS scores were particularly appropriate and useful for my study, as they are intended to measure students' ability to use English in an academic environment (Taylor & Angelis, 2008) and are considered valid for this purpose (Chapelle, 2008). In addition, the range of scores on these exams would provide an indication of the students' level of proficiency, giving some variability that might facilitate statistical analysis and which would reflect the diversity of language abilities that students in this sample possess.

I next checked for students who were labeled in the institutional data as having international student status, and I found that of the 39 first-year students who had submitted TOEFL/IELTS scores and were not missing other data, 36 fit this category. After examining other available data, I chose to keep two of the remaining three TOEFL/IELTS test-takers. One had ample supporting data to indicate IS status, including attendance at a high school in China, and the other had graduated from a high school in California but reported growing up speaking Farsi at home, continuing to do so presently, and using an L2-English dictionary to help study in the biology class. Since this student had submitted a moderately high TOEFL score but a low SAT

verbal score, I deemed it likely that this student would share many of the characteristics of the other ISs in the sample. I dropped the third of these students, a student who had attended high school in Saudi Arabia and whose self-report data indicated the student had spoken English in the home since birth.

I next subjected the 36 students who had submitted TOEFL/IELTS scores and who were also listed as international students to similar scrutiny, using the same data to verify that these students belonged in the IS sample. In 28 cases these students had most recently attended high school in a place where English was not the local medium of instruction (i.e., 27 in China, one in Korea), with additional data on their language spoken at home corroborating their status as ISs. Of the eight remaining cases, six were enrolled in foundational/introductory English reading or writing classes, and/or they indicated speaking a non-English language at home, perhaps since childhood, and/or they had low language test scores. On the other hand, the self-report data for the other two indicated English was the dominant language. I thus removed those two students from the sample, arriving at a final IS sample size of 36.

Identifying an English-dominant domestic sample in the quantitative data. To put the data on ISs in this context in sharpest relief, I created a comparison sample of domestic English-dominant students in the same class. These were students who had not taken TOEFL/IELTS exams, who were not labeled in the institutional data as international students, and who had attended high school in the U.S. Furthermore, their self-report data indicated learning and use of English alone, as indicated by the following responses:

- "Was English your first language?": *Yes*

- “What language did you learn to speak first?” (open-ended): *English (only)*

- “Was English the primary language spoken at home when you grew up?”: *Yes*

- “What language do you speak at home (e.g., with your parents)?” (open-ended): *English (only)*

The resulting English-dominant sample had 189 students. Comparing ISs with English-dominant domestic students (“EDSs”) allowed for the juxtaposition of those students who may be most likely to encounter language-related issues as a barrier to learning content with those students who would be considered least likely to face such barriers.

Descriptive statistics. Institutional and survey data (Table 4.1) revealed that the English-dominant sample was more diverse, at 41% Asian, 28% Hispanic/Latino, 18% White/Caucasian and 10.6% African American/Black, whereas the IS sample was 94% Asian. None of the EDSs in this sample reported speaking another language at home (this was by design, as it was a determining factor in labeling these students as EDSs); conversely, none of the ISs spoke English at home, and 89% spoke Chinese. The remaining four students in the IS sample comprised two speakers of Korean, and one each of Farsi and Gujarati. The EDS sample had more students from low SES backgrounds (30% of EDSs vs. 14% of ISs) and more students who were first-generation college-goers (37% of EDSs vs. 17% of ISs). Both samples were close in age, and were each 75% female.

Table 4.1 Descriptive statistics

	EDS	IS	T statistics	P-values
Male	24.9%	25%	-0.02	.987
Asian	41.3%	94.4%	-6.32**	.000
Hispanic/Latino	28%	0%	3.73**	.002
White/Caucasian	18%	0%	2.80**	.006
African American/Black	10.6%	0%	2.06*	.041
Other	2.1%	5.6%	-1.17	.242
Average Age	18.4 yrs	18.6 yrs	-4.05**	.000
First Generation College	36.5%	16.7%	2.33*	.021
Low SES	30.2%	13.9%	2.01*	.046
Chinese spoken at home	0	88.9%	-38.71**	.000
English spoken at home	100%	0	.	.
Spanish spoken at home	0	0	.	.
Other languages at home	0	0	.	.
Observations	189	36		

P values derived from independent samples t tests. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 4.5 provides additional information about the IS sample, showing that their TOEFL scores range from 81 to 107. This corresponds with a range from the 47th to the 92nd percentiles across the population of takers of the TOEFL in 2016 who were applying to colleges or universities as undergraduate students (Educational Testing Service, 2017).

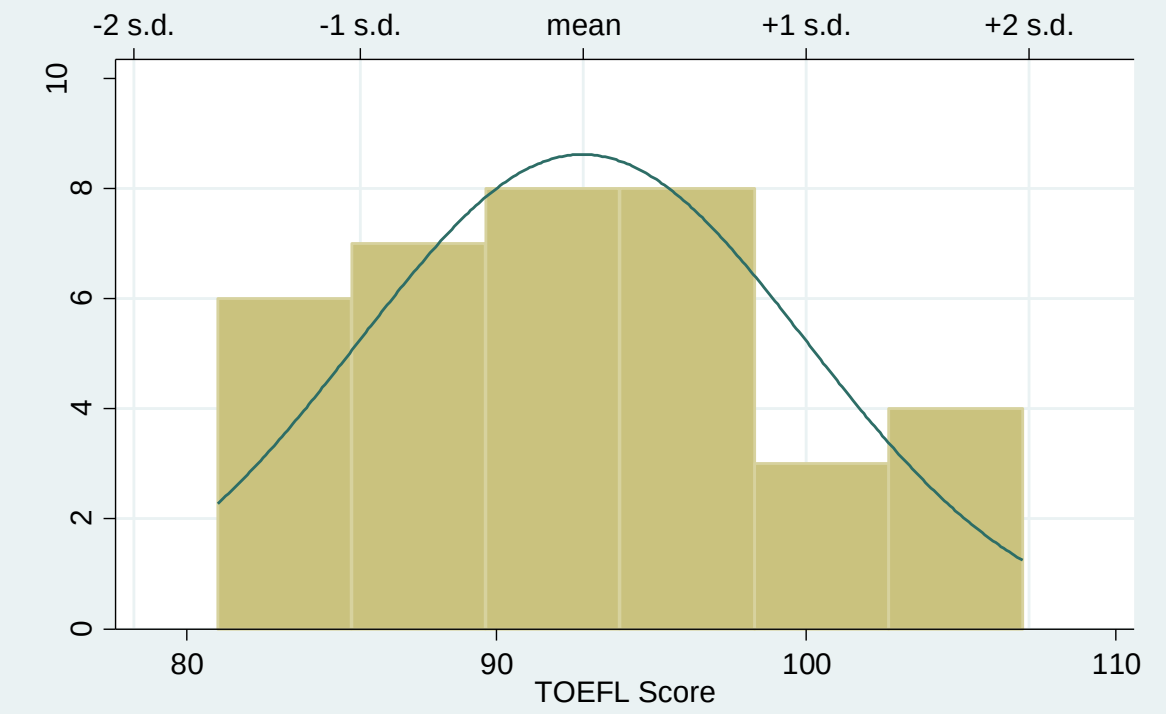


Figure 4.5. TOEFL scores for IS sample. Includes one IELTS score (7) converted to TOEFL scale (97.5).

As shown in the correlation matrix in Appendix C, biology class scores were moderately correlated with SAT (from .44 to .57) and TOEFL scores (.54), and TOEFL scores were moderately correlated with SAT verbal scores (.64). The components of the active learning composite (described below) were moderately correlated with one another, but not with any other variables. In addition, low-income status was moderately correlated with first-generation status (.44).

Methods of quantitative analysis. Having identified comparison samples of ISs and domestic EDSs, I initially approached the first research question by comparing ISs' average course grades with those of their English-dominant peers, and I drew from institutional data to compare their SAT scores as well, to see how the two samples may differ in terms of academic ability.

I next examined scatterplots of the data to confirm that there were linear relationships between outcome and dependent variables, and I used multiple linear regressions to ascertain the impact of IS status (coded "0" or "1," with "1" indicating IS status) on final grades, using students' raw scores on the 1000-point scale that the instructor employed. I regressed these grades on IS status, adding controls for their gender, and status as a first-generation college student (as a proxy measure of parents' education/socioeconomic status). I used SAT math scores, which tend to be highly correlated with introductory college science course grades (Sadler & Tai, 2007), as a proxy measure of their general academic ability that would not be overly influenced by language proficiency. I decided against using SAT verbal scores as a control in the same initial model because of their moderately high correlation with TOEFL scores (.64).

Multiple regressions are conducted under the assumption that there is no multicollinearity (i.e., that the independent variables are not highly correlated with one another), which can be tested using Variance Inflation Factor values (James, Witten, Hastie, & Tibshirani, 2017). Whereas a factor of four or more might be a concern (Hamrick, 2013), none of the factors for my independent variables (IS, TOEFL/IELTS, SAT math, SAT verbal, first generation status, gender) were higher than 1.66. This indicates that there was no issue of standard errors being inflated by multicollinearity.

I used two common tests for heteroskedasticity, the Breusch-Pagan test to check for any linear form of heteroskedasticity, and the White test to check for non-linear forms. In both cases, p values indicated there was not a significant relationship between the independent variables and the squared error term, thus meeting the assumption of homoskedasticity.

To answer the second research question, regarding the impact of certain individual characteristics on ISs' performance in the class, I looked at the IS sample alone (n=36) and regressed various measures on their grades in the form of total points out of 1000. As a proxy for language ability I used their TOEFL scores (n=35) or IELTS scores (n=1), converting the IELTS score to a comparable TOEFL score as designated by the Educational Testing Service (2010) to facilitate analysis. I used SAT math scores as a measure of academic ability that would be less influenced by second language proficiency. To tease out any relationships between the students' engagement in active learning techniques and their class performance, I assembled a proxy measure of the students' perceived importance of active learning techniques from a composite of relevant post-course survey responses. For this active learning composite, I drew together items related to in-class activities that were departures from traditional teacher-centered lecturing practices. These activities included talking to neighbors, engaging in extended discussion periods of question and answer between instructor and students, and using student response systems (3 items: using clickers, using clickers a 2nd time after talking to a neighbor (i.e., peer instruction), and using Kahoot!). As all items used the same scale ("very unimportant to my learning of class material" = one to "very important to my learning of class material" = five), I was able to form the composite as an average of student responses across the five items. Internal consistency of this composite, as measured by Cronbach's alpha, was

0.84. This suggests more than adequate internal consistency, as scales with as few as three or four items should aim for reliability coefficients above 0.70, and well-developed scales with as few as ten items should be closer to 0.80 (Dörnyei, 2007; Guilloteaux & Dörnyei, 2008). Because my sample size was low, I ran the regressed biology scores on the active learning composite alone as well as with the SAT math and TOEFL controls, to see if there might be a relationship that would not be discernible with three independent variables due to low power.

Limitations. Naturally, the generalizations that can be made from these findings are rather limited. To confidently make statements about the broader population of ISs in higher education, I would need to work with a large sample of international and English-dominant students from many different classes. Furthermore, in the case of my study the small sample size of ISs limits the potential of identifying differences that are statistically significant. This circumstance was not helped by the need to drop cases who met my criteria as ISs but who did not complete the post-course survey. The nature of my study design also precludes me from identifying causal relationships among active learning, academic ability, language ability, and grades, though there may be correlations. Though SAT math scores provide a means of measuring academic abilities without undue influence of language skills, they are imperfect indicators, for there is obviously more to academic aptitude than math ability, and it is entirely possible to be academically gifted without receiving high marks on math tests. As for TOEFL scores, though they are widely accepted proxy measures of ability to use English in an academic environment (Taylor & Angelis, 2008) and are considered valid for this purpose (Chapelle, 2008), their relationship to the study of biology is uncertain, as they do not assess the specialized kinds of language necessary for this field. There is also a concern about omitted

variables, such as motivation or prior study of biology, for which I did not have data but which might also influence students' biology course scores. Finally, a concern regarding the post-course survey is that it had 95 items and thus risked inducing survey fatigue (i.e., diminished respondent capacity to give thoughtful answers).

Constructivist Research Design

In the second part of my study I took a constructivist approach to the collection and analysis of open-ended data to arrive at answers to the third, fourth, and fifth research questions:

RQ3: What are the ways in which ISs engage in a large introductory biology class during time dedicated to active learning? What are ISs' perceptions of the utility of these practices?

RQ4: What resources and components of the class do ISs use to support their content learning in this context of active learning? What are ISs' perspectives on the utility of these resources and components?

RQ5: What are the language-related challenges and opportunities associated with the class, from the perspective of the ISs and the instructional staff?

My approach to these questions followed principles of constructivist research, based on the view that individuals develop their own subjective meanings of what they experience (Crotty, 1998), and that "truth is, in fact, what we agree it is" (Hatch, 1985, p. 161). For this reason, my primary sources of data took the form of self reports, collected through surveys and interviews. In further keeping with constructivist principles, I immersed myself in the site for an extended period of time (Creswell, 2014; Crotty, 1998), allowing the research design to emerge

as I did so (Lincoln & Guba, 1985). As a first step toward familiarizing myself with the experiences of the students in the class, my immersion involved attending virtually all lectures and many discussion sections, as well as various other components. As I did so, questions naturally presented themselves, and the research design of the study took shape over time. Among other things, this emergent design informed the development of the interview protocols, with questions that would allow for the revelation of these participants' own perspectives on their experiences, and the meaning they make of these experiences (Creswell, 2014; Crotty, 1998).

Data collection. To find answers to the third, fourth, and fifth research questions, I drew on survey responses from the 36 students in the IS sample, data from interviews with four ISs, ten TAs, and the instructor, field notes, and course materials (e.g., the syllabus and podcast recordings of lectures).

Survey data collection. As described above, students received modest extra credit for completing the post-course surveys (Appendix A) by following a link on the course website. Post-course survey data relevant to the research questions take the form of responses to closed-ended questions (i.e., Likert scale and multiple-choice items), as well as three open-ended questions toward the end of the survey that were directed specifically toward ISs. These questions were prefaced with the instructions that they were "for students whose first language is not English. Only answer if English is not your first language."

Recruiting interview participants. To select student interview participants, I followed a purposeful sampling strategy (Patton, 2015), recruiting first-year students who were new to the U.S. and who had not previously studied content through English extensively, and who thus had

the potential to advance our understanding of ISs' experiences in content classes of this nature. Initial recruitment strategies included posting signs in English and Chinese on the entrances and exits of the class, as well as two announcements from the professor, one posted on the course discussion website and one placed at the start of a class session's PowerPoint, which was shared with all students and which the professor referred to during his opening announcements. These signs and announcements cast a wide net, encouraging participation from anyone enrolled in the class who was an international student and/or speaker of English as a second language. As a result of these strategies I received a few emails of interest, but initial vetting revealed that for the most part these students did not match my criteria. Ultimately, I was able to schedule three of the four interviews with Chinese students as a result of chats I had with these students during my time at the lecture site, and the fourth interviewee was recruited via "snowball sampling," as she was invited to participate by one of the initial three interviewees.

Interview protocols. Interviews followed a semi-structured fashion, in which I sought to facilitate discussion on a set of core topics relevant to my (evolving) research questions, derived from my reading of related literature and from my experiences observing the class. For ISs, background topics included the interviewee's current class schedule, length of time in the U.S., and previous English language learning history (Appendix B). With regard to the biology course, I attempted to give the interviewees a chance to express their perspective without a great deal of influence from me by asking "grand tour" questions (Spradley, 1979) that requested a description of what happened during a typical lecture or discussion section. I then probed more specifically to find out about the interviewees' ways of engaging in particular aspects of the

class (e.g., the use of clickers, discussion with peers and with the instructor). Other interview topics included study habits, use of various forms of support, strategies for understanding challenging parts of class, acquaintances acquired through the class, and use of laptops/smartphones during class.

Interviews with TAs followed a separate semi-structured protocol (Appendix D) that included open-ended questions regarding their experiences with ISs in their discussion sections and office hours, their observations of international student behavior during lecture, and particular teaching practices and student behaviors I had observed during my visits to their discussion sections.

Prior to the start of the class I had two meetings with the instructor in which I learned background information about the course, the students, and the department. After the conclusion of the quarter, we had one semi-structured interview via Skype. Interview topics included a grand tour overview of a typical lesson, rationales for various teaching practices, and observations regarding ISs in the class. In addition, I met with the instructor one more time one year later to discuss findings, as a form of member checking.

***Additional interview-related data*.** Following each interview, I recorded field notes and memos of my impressions and the ideas that the interview sparked for me. After interviews with students, I also made a point during my future classroom visits to include these students in my observational field notes when possible.

Profiles of interviewees.

Yang. Yang is a first-year male with an undeclared major from Taiwan who "always wanted to start a career related to biology." He thought, "if I come to America I have better

chance to participate in internships or something and I have more chances to learn more knowledge about what I am interested in." Ultimately, he said he wanted to be involved in bio tech or the food processing industry, preferably in America, though in a member-checking interview one year later he said his dream was to be an entomologist.

Yang first came to the U.S. at the start of the school year, two months prior to our interview. He had studied English since elementary school, and his TOEFL score was around the 65th percentile. His placement in the third level of academic English indicates proficiency sufficient to skip two lower levels but not quite sufficient to join mainstream students in the first lower division writing class required of all students (in Yang's words, part of the distinction is between grammar-focused classes that ISs are ordinarily placed into and classes that U.S. students would ordinarily be placed into, which are more focused on the content of students' writing). In a self-assessment of his own language skills, he said,

> When I speak sometimes I will use the wrong words and then I realize, then I correct it, but sometimes it will still be wrong or also the fluency, like, I sometimes stutter or something and also correct pronunciation of words.

During the interview he always seemed to find appropriate words and gave little or no evidence of difficulty understanding my questions.

Yang's interview responses were characterized by ample awareness of instructional design, as he seemed to describe rationales for teaching practices in terms that seasoned educators might use, noting practices that made the teacher more approachable, listing the benefits of interacting with a range of peers, providing his reasons for not using his cell phone

in class, and explaining his practice of taking notes by hand as opposed to typing on a computer.

In Taiwan Yang attended a bilingual school, in which most classes were taught through traditional teacher-centered methods, though his English class was taught by a "foreigner" who would use "a type of interactive active learning" through such means as calling "two students to compete at the front of the board or something and students who are seated can help those on their team."

At the end of the course Yang's grade was a C+, though in his interview during the last week of the class he was anticipating a B. During the member-checking interview one year later, he shared that he decided not to pursue a biology major because the organic chemistry requirements were too difficult.

Gladys. Gladys is a first-year student from China. At the time of the interview, she was a biology major, but she said she wanted to change to pharmacy. She came to the school "because actually I like California and this is only school took me." Though she started studying English in first grade, attending university in the U.S. was her first time living outside China and her first time studying content through English.

Regarding her language skills, she felt confident in her abilities in general (pronunciation, reading, writing) but felt the need for improved vocabulary and speaking skills. She was placed into the second course in the three-course Academic English sequence, indicating that she needed two terms of foundational English support prior to joining the mainstream writing course. Her TOEFL score was around the 58th percentile. Though she spoke rather fluently and had comprehensible pronunciation, during our interview she tended to give

brief responses, and we had occasional minor communication breakdowns in which it seemed she did not have the skill to express her meaning clearly. This happened most notably when we discussed her behaviors during peer instruction, those times when students respond to a clicker question, discuss their answers with a peer, and then use the clicker to respond to the same question again:

Interviewer: Ok. sometimes he asks you to do the clickers two times, on the same question, right? Why does he do that?
Gladys: Because he wants us to talk with each other change our mind and get our accurate answer.
Interviewer: Ok, so what happens for you when he does that?
Gladys: I talk to my neighbor.
Interviewer: And do you change your mind?
Gladys: Uh yes many times.
Interviewer: So are you saying that usually you have the wrong answer and then you get the right answer after? Or-
Gladys: I mean in multiple choice. I always leave a right answer.
Interviewer: In the first time or the second time?
Gladys: The first time.
Interviewer: So the first time you get the right answer?
Gladys: No the four correct answer, maybe just a two but the correct answer is three.
Interviewer: Ah, are you talking about questions where he says, "Click all the ones that are wrong" and you have to say there are three wrong or two wrong or five wrong, something like that?
Gladys: What do you mean?
Interviewer: He asks so many different kinds of questions. But usually there is just one answer to the question – A, B, C, D, and so usually the first time you choose an answer, and then you talk to your partner, and then do you change your answer or keep your answer?
Gladys: Keep my answer but I get more information about the question.
Interviewer: So usually you keep your answer but you think about it more from talking.
[Later in interview –]
Gladys: I like talk to my friends, neighbors and change my mind.

Gladys' prior educational experiences in China were mostly traditional, though she credited the development of her speaking skill to her experience with an American teacher of

English who promoted more discussion in class. She reported that prior to coming to the U.S., her friends told her about differences in the school cultures:

> In China teachers can tell you everything and, uh, make you know how to get high grades, how to and where to take practice, and teachers will tell you everything. Our teachers will spend many times on your examination for you to prepare for it, but in America you need to study by yourself beyond class, you need to spend more time to revise to prepare for class.

Perhaps as a result, her interview responses indicated a preference for learning the content independently, as she eschewed such program offerings as office hours in favor of looking things up online or working with her friends. She stated a preference for studying from the class PowerPoints and pre-class assignments, and did not favor the textbook because it is "too heavy" (though she was using the electronic version) and "the content is too much." At the end of the quarter she received a D for the course, and in a follow-up interview her friend Maxine told me that Gladys later changed to a major that was not related to biology or pharmacy.

Harry. Harry is a first-year student from China who attended an international high school. The teachers were Chinese, but had themselves attended school abroad. They taught in English and used American textbooks, but they had recourse to Chinese when students were confused or couldn't understand. Because he took AP chemistry in high school, he did not have to take it at university. Instead, he took math, because "math is great, I just like it."

At the time of the interview he was living in a house off campus with other students from his high school, none of whom were in his same biology class. He first came to the U.S. at the start of the school year, entering university as a biology major, but he said he intended to change his major to something else, and he had only selected biology as his major on the advice that it would strengthen his application.

Although he started learning English in elementary school, he said “I really, I didn’t like it so just my English is very bad at that time. I started to learn it, actually learn it is in high school.” He said that the first time he took the TOEFL, his score was quite low, and so he had to take a class on the weekends to help him improve his score. According to his records, he ultimately scored around the 58th percentile for his application to college. Upon entry to school he was placed into the lowest level of Academic English, indicating that he would have to take the full sequence of three foundational courses before he would be able to join the mainstream writing course required of all undergraduates.

Unlike most other students in the class, Harry did not ordinarily bring a laptop or notebook to class, did not print out the slides, and did not take any notes. He explained, “Actually when I first came to the lecture I did take notes but actually I found out that the lectures, some key points of the lectures is totally the same as I learned from the textbook or the pre-class assignment so I think it’s not necessary.” Otherwise, on the seven days when I could observe his behaviors in class, I saw that he paid attention to the lecture and responded to clicker questions, and spoke to his neighbors during many but not necessarily all of the times when that was requested.

By way of explanation for not attending office hours, he said, “I think I just not well prepared for the college life because this is the first year for me. I just not very, you know, just sometime I just want some I just want to have fun I want to have a rest and something like that.” He also shared that he was surprised at how much time other people spent studying for the midterm exam, whereas his approach was to do the practice exam and read the book, “just let me think and maybe not really hard working.” At the end of the course he got a B.

Maxine. Maxine is a first-year biology major from China who came to the U.S. to live with her grandparents in another state for one year after finishing high school. Although she had studied English since elementary school and she placed in about the 84th percentile on the TOEFL, she had never taken a content class that was taught through English, and when she entered the university she was placed in the second level of foundational writing. At the time of the interview she was living with "local people" as roommates, which she expressed as a conscious decision to improve her English instead of taking the easy path of living with other Chinese students. She seemed to lack confidence in her language skills, as she expressed fear of being laughed at if she spoke up and said the wrong thing in class, and she said she would not speak first during pair work unless it was someone she already knew.

She is a hardworking student who went to great lengths to prepare for the exams, seeking clues regarding the content and nature of the exams in the instructor's lectures and clicker questions, and getting as much practice as she could from review sheets offered by peer tutors, worksheets from TAs, and the practice exam from the instructor. To check her answers to all the questions on the practice exam, she distributed her queries across visits to several TAs and the instructor. In the end, she got a perfect score in the class.

This hard work had a cost, as she said she felt a lot of stress because she had to maintain her GPA and keep on track so she could follow her plans to go to medical school. She stated that the class was causing her to lose sleep, as she had to stay up to do readings and pre-class assignments, catch up to the class, and prepare for exams. Meanwhile, many other things made demands on her time as well, such as cooking for herself, daily video calls with her family in

another part of the U.S., and her new two-hour per day job as a maintenance lady in her campus hall.

Despite feeling stressed and tired, she made a point to add that she also feels really happy, “even though I’m so tired and stressful. I feel I can really learn something here and I can really do something real, like meaningful.”

Analysis. Generally speaking, analysis of survey responses afforded a view of overarching trends among ISs in the class, whereas the richer interview data permitted greater depth of analysis and discovery, and field notes and course documents contributed contextual information and served as a check on the other data.

Survey data. My analysis of the closed-ended IS survey data consisted of tallying response percentages and organizing them by theme in order to gain a representation of overall trends. I analyzed the open-ended responses through in vivo coding (Saldaña, 2012), highlighting salient and recurring statements in a fashion intended to permit themes to emerge from the participants’ own words, without preconceived categories. I identified patterns across responses and reorganized data into emergent categories accordingly. As these responses tended to be concise and similar, they lent themselves to quantification (e.g., noting the number of respondents who identify a particular kind of language challenge). Naturally, the categories that emerged from this analysis pointed toward areas for further consideration as I examined my interview data. I also identified which survey responses came from the ISs who had participated in interviews, so that I could gain further insight on the perspectives of those interviewees, and also so I could recognize patterns in the data both within and across cases.

Interview data. To maintain a close connection to my data, I personally transcribed each of the student interviews, listening to the recordings repeatedly and refining as necessary. As the interviews were semi-structured, a first round of holistic coding (Saldaña, 2012) or typological analysis (Hatch, 2002) based on my conceptual framework and the broad question topics in the interview protocol (e.g., use of clickers, peer discussion) then provided a natural point of entry to the data. I applied these holistic codes to conversation chunks that were at least one question-answer exchange in length, but frequently more than three times as long as that.

From that point forward I engaged with the data in an iterative fashion, visiting and revisiting them from various angles and with various purposes. My processes included the following:

- I subjected passages of particular relevance to my research questions to deeper coding and analysis (see Appendix E for sample codes, descriptions, and examples), looking intensively within cases for patterns and contrasts, and then doing the same across interview cases as I placed passages on the same topic together, noting trends and anomalies in memos. When I encountered patterns, I checked the strength with which these associations indicated the existence of broader patterns and trends "by thinking through counterfactuals and problems of reliability and representativeness" (Lin, 1998, p. 166).
- When I encountered passages that resisted straightforward interpretation, I either shared them with research colleagues to check my assumptions, or I shared them with IS research assistants who were not part of this study as a form of member checking.

- To avoid missing valuable information and being blinded by the things I was looking to see, I also examined the transcripts from a more inductive approach (Crotty, 1998), particularly those passages not obviously suited to the holistic codes. In this fashion, I sought deeper meanings within the participants' own perspectives, looking for insights that may have been obscured by my initial focus on the broader categories of interest denoted by my question topics and holistic codes.
- I undertook my examination of the student interview data over an extended period of time, with periods of intense analysis separated by periods in which I focused on other parts of the data such as the statistical analysis of survey data and the typological analysis of TA and instructor interviews, along with other periods in which I stepped back for a "view from the balcony," reacquainting myself with a broader perspective on the course drawn from field note memos, the syllabus, and other sources. In all, this analysis took place over a period of more than 14 months. This ongoing perspective-taking from various angles developed and at times challenged my overall sense of the data, helping me avoid becoming wedded to superficial interpretations and first impressions, and it allowed me to ground my analysis within the context of the research site.
- To further disrupt any assumptions I may have inadvertently made and thus to facilitate further discovery, I also sought and made use of opportunities in the data to apply alternative means of interpretation, such as domain analysis (Spradley, 1979), metatheories (Feldman, 1995), and heuristics (Abbott, 2004; Vaughan, 1992).

Through this process, I generated meaning in an iterative fashion, with answers to research questions "emergently constructed as more and more data are… systematically examined" (Saldaña, 2015, p. 26).

Trustworthiness and credibility. As is typical of research of this nature, I "assume that complete knowledge is impossible, and indeed that all conclusions must be uncertain" (Lin, 1998, p. 170). To address this uncertainty, I first had to recognize my own subjectivity and its potential impact on my analysis, and I then needed to take measures to "bracket" these prior influences on my analysis (Locke, 2001). In addition, I checked the faithfulness of the data via means typical of interpretivist research, by checking my "interpretations against the criticisms of peers, against the reactions of the members of the group being studied, and against as many different kinds of observations as possible" (Lin, 1998, p. 171).

Subjectivity and bracketing. In Maxwell's (2013) terms, qualitative research is concerned with how a "researcher's values and expectations may have influenced the conduct and conclusions of the study … and avoiding the negative consequences of these" (p. 124). In other words, it is important that researchers engage in reflexivity, explicitly reflecting on the assumptions we may make when we engage in knowledge-making and knowledge-presenting (Locke & Golden-Biddle, 2002), addressing the ways our prior experiences and biases may influence the way we interpret the data we collect. In addition to bolstering the integrity of our work, such reflexivity allows for "bracketing," in which researchers "work to surface and examine our biases and pre-existing theoretical commitments specifically so that we can 'bracket' them out" in order to focus on the data and think creatively about them apart from personal biases that may prematurely shape conceptual categories (Locke, 2001, p. 46).

Most relevant and influential of my prior experiences is my lengthy experience as an educator, including almost 20 years as a teacher of ESL in the United States and of EFL in Spain and Japan. From this I have gathered experience working with learners of English from around the world, many of whom were similar in age to the participants in this study. My extensive experience with these students was useful in helping me avoid essentializing them in terms of cultural stereotypes, as I have seen firsthand the great diversity within cultures, but it also had the potential to incline me to see these individuals through the eyes of a teacher. When I took that perspective, I took a natural interest in the extent to which the students seemed to understand lessons and participate appropriately, noting whether they remained "on task" or diverged during lessons. Of course, such experience in the classroom was a useful resource as I sought to understand this educational context, but I nonetheless also needed to be able to set it aside and put myself in the shoes of the students who were the primary focus of my study.

In addition, my more than ten years as a teacher educator have helped me develop an inclination toward particular pedagogical practices, many of which could be considered active learning. For instance, current trends in language instruction favor collaborative learning, the use of class time for students to experiment with and apply what they are learning, and a focus on creating comfortable learning environments, all practices that were also evident to varying degrees in the research site, and which I was thus inclined to take note of. My personal preference for such practices is likely reinforced by my lengthy experience as a university student myself. Still, any inclination to focus on such classroom practices should not be overly problematic to my analysis, particularly as these elements of the class are essential components of active learning, and thus are central to my research questions. The key was to remain

cognizant of the possibility that active learning might not be for everyone, and to remain open to witnessing and hearing about positive, negative, and neutral experiences.

There are a number of other assumptions I might be inclined to make about the experiences of these students, as I see parallels to my own experiences. As a lifelong student of the humanities, I may tend to see biology as a "difficult" subject, and this may inform my belief that learning such content through an additional language is especially challenging. In addition, the six years that I lived in Japan provides me with personal experience of what it can be like to live in a distinct culture far from home, though of course my position as a mature, married, white male teacher there made for an experience quite distinct from that of a young IS in the U.S. Furthermore, my experience abroad informs values relevant to this study, as I assume there is great value to cultural exchange, and that it is incumbent on us as citizens of the world to facilitate visitors' inclusion in U.S. society.

Whereas each of these perspectives required bracketing during my analysis, I should note that they each also served as sources of strength insofar as they engendered a sense of affinity toward the research site and fueled my enthusiasm to undertake this project and see it through to completion.

Peer feedback. In the first months after I completed data collection, my participation in a course in advanced qualitative research methods gave me opportunities to test out various approaches to interpreting my data. During the weekly class sessions, these preliminary attempts were exchanged with peers and discussed at length, with frequent occasions for reflection on the lenses I was using to interpret the data.

In the later stages of my work I was able to share passages that resisted straightforward interpretation with colleagues at collaborative research meetings in a non-directive fashion, to gain fresh perspective and check my assumptions. I then made revisions to codes as necessary. Further insight from peers farther afield came as I shared preliminary findings at professional conferences (i.e., AAAL, TESOL) and through the peer review process as I submitted components of the dissertation for publication.

Member checking. As I underwent the process of coding and recoding the data and identifying patterns and anomalies, I pursued opportunities to discuss my initial findings with ISs who were working with me as research assistants, to seek further illumination regarding issues of interest. Though these students were not members of the biology class I was investigating, they were ISs who were L2 users of English, and thus were members of the same target community. I also shared initial findings with the instructor and gained his input.

Checking in relation to a large, varied body of data. I took the role of researcher as *bricoleur* (Denzin & Lincoln, 1994), collecting as much data as possible by attending every day of lecture but one (and watching the podcast for that one), interviewing four ISs, the instructor, and all ten TAs with classroom responsibilities, collecting survey responses from 792 students, and including such other forms of data as course documents and grades. This was particularly important given that I primarily rely on self-report data in the form of surveys and interviews. Though it is tempting to assume that self-reports are generally accurate, and that participants do their best to make truthful representations of their behaviors and perceptions, there are numerous limitations, such as "social desirability bias" in which people cast themselves in a better light than may be accurate (Lavrakas, 2008), or the issue of respondents "helpfully"

telling a researcher what they think the researcher wants to hear. In addition, human memory is imperfect, as is our capacity for self-awareness.

For all these reasons, I checked my student interview and survey response data against numerous secondary sources of information, including course documents, field notes, and interviews with the instructional staff. The thoroughness of this approach to data collection and analysis allowed me to triangulate my findings across different kinds of data, from different sources, collected at different times (Maxwell, 2013), adding dimension to my interpretations as I checked for disconfirming evidence.

Chapter Five: ISs' Achievement in a Class that Uses Active Learning Techniques

In this chapter I investigate ISs' achievement in the class in comparison to their domestic, English-dominant peers, and I then examine the associations between certain IS characteristics and ISs' success in the class. Specifically, I focus on the following research questions:

RQ1: In comparison to their English-dominant domestic peers, how well do ISs perform in a biology course taught through the use of active learning?

RQ2: For these ISs, how are factors such as English language proficiency, academic ability, and receptiveness to active learning associated with their performance in the course?

I began by narrowing the class sample to students who were in their first year and who were thus having their first experiences of active learning in U.S. higher education, and I dropped all cases who were missing data essential to my analyses (i.e., post-course survey data, and for ISs, TOEFL/IELTS scores). I then scrutinized the survey and institutional data from the students in the IS sample for evidence that might disconfirm that they were L2 users of English who might reasonably be expected to face language-related challenges to content learning, and I narrowed the sample further as necessary. For comparison, I created an EDS sample of students who would be expected to face few or no English-related challenges to learning the content, based on multiple data points indicating that English was their only language. Through these processes I arrived at an IS sample of 36, an EDS sample of 189, and a whole-class sample of 698, which encompassed the IS and EDS samples, as well as all other first-year students who were not missing crucial data.

ISs' Performance in Comparison with EDSs

I approached the first research question by comparing ISs' average course grades with those of their English-dominant peers, and I drew from institutional data to compare their SAT scores as well, in order to see how the two samples may differ in terms of academic ability. On average the ISs seemed to outperform EDSs on their biology course grades ("Total Bio Pts"), with a mean that was 38 points higher (Table 5.1). Though this difference was not statistically significant, according to the instructor's scales it amounted to roughly the difference between a B (725-754) and a B+ (755-794).

We can see indication that the two groups differed in other ways related to academic performance. The ISs had SAT math scores that were significantly higher than their English-dominant peers (p<.01). Notably, EDSs did significantly better on the SAT verbal portion (p<.01). However, when it came to SAT writing scores and total SAT scores, the two groups were not significantly different.

Table 5.1 Biology course grades and SAT scores

	EDS				IS						
	Mean	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Diff.**	**T stats**	**P-val**
Total Bio Pts	752.2	110.8	479.4	995.2	790.0	111.8	530.4	1002.0	-37.8	-1.87+	.063
SAT Total	1724.8	196.4	1360	2240	1778.1	168.0	1470	2140	-53.2	-1.52	.129
SAT Math	569.8	76.7	400	800	720.6	77.0	490	800	-150.8	-10.80**	.000
SAT Verbal	583.4	85.3	420	800	502.2	71.1	390	680	81.2	5.36**	.000
SAT Writing	571.6	68.3	420	800	555.3	73.5	430	720	16.3	1.30	.196
Obs	189				36						

Total Bio Pts is out of 1000. "Diff." denotes the difference between means. P values derived from independent samples t tests on the means. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

I next used multiple linear regression as a more nuanced way of determining how well ISs performed in comparison to other students in the class, regressing final grades in the form of students' raw scores on the instructor's 1000-point scale on IS status alone (coded "0" or "1,"

with "1" indicating IS status) and also in combination with a small set of controls (gender, first-generation status, and SAT math scores) (Table 5.2), using the following equation:

$$\textit{Biology Final Scores} = a + b_1\,\textit{IS status} + b_2\,\textit{academic ability (SAT math)} + b_3\,\textit{gender} + b_4\,\textit{first-generation status}$$

I first used the subsample of ISs (n=36) and domestic English-dominant students (n= 189), to juxtapose those students who may be most likely to encounter language-related setbacks as a barrier to content learning with those students who would be considered least likely to face such barriers. I then ran parallel regressions with the full class to see if the outcomes were similar.

Table 5.2 Total scores regressed on IS status

	Subsample of ISs vs EDSs (raw)	**Subsample of ISs vs EDSs (stdzd)**	**Subsample with controls (raw)**	**Subsample with controls (stdzd)**	**Full class (raw)**	**Full class (stdzd)**	**Full class with controls (raw)**	**Full class with controls (stdzd)**
IS	37.78 (20.18)	.31 (.17)	-74.25** (21.55)	-.61** (.18)	44.13* (18.98)	.37* (.16)	-60.23** (17.98)	-.50** (.15)
SAT Math			.73*** (.09)	.51*** (.06)			.67*** (.05)	.47*** (.04)
Male			4.73 (14.98)	.04 (.12)			18.85* (8.47)	.16* (.07)
First Generation			-10.17 (14.07)	-.08 (.12)			-7.04 (7.75)	-.06 (.06)
Constant	752.20*** (8.07)	.12 (.07)	338.98*** (51.14)	.19* (.08)	745.85*** (4.31)	.06 (.04)	365.66*** (29.38)	.11* (.05)
N	225	225	225	225	698	698	698	698
R^2	.016	.016	.282	.282	.008	.008	.257	.257

Notes. Data points are coefficients on independent variables, with standard errors in parentheses. Raw biology scores are on a 1000-point scale. IS is a dummy variable for international student (coded "0" or "1," with "1" indicating IS status), Male is a dummy variable for gender (coded “1” for male), and First Generation is a dummy variable coded “1” for status as a first-generation student. Standardization (“stdzd”) applies to both biology scores and SAT math scores. Samples comprised of first year students without missing data. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In these regressions we see that whether we compare ISs to the class as a whole or to the EDS subsample alone, the results are quite similar. Without controlling for math aptitude, gender, or first-generation status, ISs on average appear to be getting final scores that are 38-44 points higher (out of 1000) than their classmates, roughly one-third of a standard deviation higher. However, controlling for math aptitude changes the picture, indicating that ISs who have the same SAT math scores as their EDS counterparts get grades that are 60-74 points worse, a point deficit that could be as little as the difference between an A and an A-, or as much as the difference between a B and a C+. These SAT math score coefficients, used here as a proxy measure of non-linguistic academic ability, indicate that if ISs are on the whole doing better in the class, it may be because of their high degree of academic ability, as represented in their SAT math scores, in spite of whatever language-related setbacks they may encounter. Conversely, it appears that these students are getting scores much lower than would otherwise be expected, if we judge based on the non-linguistic academic ability suggested by the SAT math scores alone.

It is worth noting that low-income status and first-generation status were two related variables (correlation = .44***) that distinguished the ISs from the EDSs (EDSs were 36.5% first-generation and 30.2% low SES, ISs were 16.7% and 13.9%, respectively). In the regressions, these variables did not have a significant relationship with biology scores, as Table 5.2 shows for first-generation status. Parallel regressions with low-income status swapped into the place of first-generation status similarly showed this variable to be not significantly associated, in both the subsample of ISs combined with EDSs (B = -7.03, p = .364) and in the whole class (B = -11.77, p = .123).

I next ran the same regression with SAT verbal scores in addition to SAT math scores, in order to get an indication of the impact that language skills might have on all students' performance in the class, and to see how this impact differed for ISs in comparison to the rest of the class (Table 5.3).

$$\textit{Biology Final Scores} = a + b_1\,\textit{IS status} + b_2\,\textit{language ability (SAT verbal)} + b_3\,\textit{academic ability (SAT math)} + b_4\,\textit{gender} + b_5\,\textit{first-generation status}$$

Table 5.3 Total scores regressed on IS status, with SAT verbal control included

	Subsample with controls (raw scores)	**Subsample with controls (standardized)**	**Full class with controls (raw scores)**	**Full class with controls (standardized)**
IS	.566 (23.64)	.005 (.20)	-1.23 (18.72)	-.01 (.16)
SAT Verbal	.480*** (.08)	.33*** (.06)	.397*** (.05)	.28*** (.03)
SAT Math	.501*** (.09)	.35*** (.06)	.480*** (.05)	.34*** (.04)
Male	5.23 (13.93)	.04 (.12)	18.01* (8.11)	.15* (.07)
First Generation	-3.03 (13.13)	-.03 (.11)	.362 (7.47)	.00 (.06)
Constant	186.20** 54.02	.09 (.07)	241.45*** (32.11)	.05 (.05)
N	225	225	698	698
R^2	.3822	.3822	.3203	.3203

Notes. Data points are coefficients on independent variables, with standard errors in parentheses. Raw biology scores are on a 1000-point scale. IS is a dummy variable for international student (coded "0" or "1," with "1" indicating IS status), Male is a dummy variable for gender (coded "1" for male), and First Generation is a dummy variable coded "1" for status as a first-generation student. Standardization applies to both biology scores and SAT scores. Samples comprised of first year students without missing data. $^{*}\,p < 0.05$, $^{**}\,p < 0.01$, $^{***}\,p < 0.001$

These results indicate that for students who share the same SAT math and SAT verbal scores, and who are the same gender and have the same status as first-generation college students (or not), being an IS does not have a significant impact on final scores in the class. The SAT verbal scores are significant, however, which indicates that language ability indeed matters with regard to biology class final grades, regardless of whether a student is an IS or not. It thus appears that the distinction that made "IS" a significant variable in the previous tables was most likely related to language ability and not to other factors (e.g., stigma, difficulty fitting in or finding friends, etc.). Finally, once again we also see that first-generation status is not associated with biology scores.

Relationship Between IS Characteristics and Class Performance

In pursuit of an answer to the second research question, I focused solely on the 36 students in the IS sample, looking at the relationship between these students' grades in the course and their language proficiency, academic ability, and receptiveness to active learning.

$$\textit{Biology Final Scores} = \begin{array}{c} a + b_1\,\textit{active learning} + b_2\,\textit{IS status/TOEFL score} \\ + b_3\,\textit{academic ability (SAT math)} \\ + b_4\,\textit{gender} + b_5\,\textit{first-generation status} \end{array}$$

For grades I used their final biology class scores out of 1000. TOEFL scores served as a proxy measure for language ability, including one IELTS score that I converted to a comparable TOEFL score as designated by the Educational Testing Service (2010) to facilitate analysis. SAT math scores once again served as the proxy for academic ability not impacted by linguistic ability. As for ISs' receptiveness to active learning, I assembled a proxy measure from a composite of

relevant post-course survey responses, drawing together items related to in-class activities that were departures from traditional teacher-centered lecturing practices. These activities were talking to neighbors, engaging in extended periods of question and answer between instructor and students, and using student response systems (3 items: using clickers, using clickers a 2nd time after talking to a neighbor (i.e., peer instruction), and using Kahoot!). As all items used the same scale ("very unimportant to my learning of class material" = one to "very important to my learning of class material" = five), I was able to form the composite as an average of student responses across the five items. Internal consistency on the composite was high (Cronbach's alpha: 0.84).

Table 5.4 Total scores regressed on active learning composite, TOEFL, and SAT Math

	Active learning composite	**TOEFL**	**SAT Math**	**All 3**	**All 3 plus controls, full class**
Active Learning	-.10 (.17)			.04 (.14)	.05 (.03)
TOEFL		.56** (.15)		.49** (.14)	
IS					-.53*** (.15)
SAT Math			.48** (.15)	.41** (.14)	.50*** (.03)
Constant	.44** (.16)	.45** (.13)	-.38 (.29)	-.24 (.27)	.12* (.03)
N	36	36	36	36	694
R^2	.011	.303	.224	.450	.254

Notes. Data points are coefficients on independent variables, with standard errors in parentheses. Raw biology scores are on a 1000-point scale. IS is a dummy variable for international student (coded "0" or "1," with "1" indicating IS status). Biology scores, TOEFL scores, SAT Math scores, and active learning composite standardized. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Regressing course scores on TOEFL scores and on SAT math scores individually revealed a positive and significant relationship in both cases, which suggests that ISs' grades were linked to their language proficiency as well as their non-language-based academic ability. Students who scored one standard deviation above the mean on their math SAT would have a biology score that was about a half standard deviation above the mean, on average, indicating an association between biology grades and academic ability. As for the relationship with English language proficiency, a one standard deviation gain in a student's TOEFL score was associated with a .56 standard deviation increase in their biology scores, on average. These numbers remain significant and similar in the fully controlled model for ISs only (n = 36), with the relationship between SAT math and biology scores dropping slightly in substance and significance.

Biology scores did not appear to have a similar relationship with the composite for students' perception of the active learning components as being important to their learning. Though this combination of items was internally valid, regression of students' course scores on this composite was inconclusive, as the regression yielded no significant relationship (coefficient: -.10, SE: .17). This does not appear to have been an issue of low power due to the low n size. As the model in the last column shows, regressing course scores on the fully controlled model with the full class sample (n=694) yields a coefficient for the active learning composite that is also not significant.

In sum, it appears that language ability was associated with students' grades in the course, and that for ISs this relationship could lead to lower biology scores relative to their academic potential than it would for EDSs. As for the relationship between active learning and

biology scores, no conclusive findings were discovered through multiple linear regressions using the active learning composite, which was based on survey responses regarding students' perceptions of the importance of various active learning techniques. It appears that either this form of information was not a useful measure, or there is no particular association between the two. In the next chapter I seek clarification of this matter as I turn to open-ended survey responses, interview data, and field notes in an alternate approach to the analysis of the relationship between the use of active learning techniques and ISs' learning of the course content.

Chapter Six: ISs' Engagement in Active Learning

When students attended the large lectures three times a week, they experienced classes that blended instructor-driven content with various forms of active learning, including class-wide discussions, use of clickers, and peer instruction (in which students discussed their individual responses to a clicker question with one another, then responded to the same question a second time). For variety, the instructor occasionally used Kahoot!, a game-like app in which students competed to answer quiz questions quickly, and at other times lecture segments were made interactive through such practices as having students use hand gestures to make predictions about trends on graphs or to work out complex processes like mitosis. According to the instructor, this variety in the use of active learning was by design:

> I like to mix it up. … I just have them [draw] in the air, or have you do thumbs or thumbs down, or hold up fingers, or there's so many different ways you can poll and get responses and get them involved. So it's more of keeping them on their toes and mixing it up, regaining their attention span. …That includes like playing a video or you know, asking a student question of the whole class or having them talk to each other without anything more than that right? So just to get them, get them engaged and get them to do something to help apply what they have been learning.

In addition to these interactive but large lectures that used active learning to have students "apply what they have been learning," students were required to attend small weekly discussion sections that involved a more intimate form of active learning, through group work, collaborative quizzes, and other activities with their TAs.

All of these active learning practices took place in a context of high structure course design. Students were required to prepare for class daily by completing pre-class assignments online, and they had weekly online quizzes to assess their learning, which all could contribute

to keeping students on track to meet the overall course objectives. In addition, oftentimes clicker questions were designed to give the students practice and experience using the kinds of higher order thinking required for the exams. These aspects of the course may have played a part in the effectiveness of the active learning, for studies show that highly structured class environments enhance the effects of active learning (Freeman et al., 2011; Freeman et al., 2007; Haak et al., 2011).

It is also notable that a significant amount of class time was dedicated to a focus on metacognition, as it is speculated that such a focus can also amplify the effects of active learning (Tanner, 2012). The instructor regularly drew students' attention to the instructional principles that informed the course design and encouraged them to think about their ways of learning, asking themselves if they were meeting lesson objectives and challenging themselves to engage with the course content at the higher levels of Bloom's Taxonomy. In addition, one week after the midterm the instructor dedicated an entire class session to a "study skills workshop" in which he explained the meaning of metacognition and made the case for the relationship between reflection on learning and academic success.

Whether ISs should find this kind of environment and these kinds of practices facilitative or detrimental to their learning is an open question, as these students tend to be left out of the research on active learning. It is possible that they may benefit from these techniques in the same way as other students. On the other hand, they may feel discomfort interacting with peers or they may question the legitimacy of departures from teacher-centered instruction, if indeed teacher-centered instruction is what they are accustomed to, or there may be other reasons for these students to encounter a kind of cultural mismatch.

In this chapter I address this question, focusing on ISs' ways of engaging in the class during time dedicated to active learning, as well as their perceptions of the utility of these practices. I begin by examining active learning in lectures and discussion sections, giving particular attention to ISs' participation in whole class discussion, clickers/peer instruction, and small group work. I then investigate ISs' perspectives on the high structure and metacognitive aspects of the course. As I do so, I draw from my analysis of ISs' open- and closed-ended survey responses and more than three and a half hours of interviews with four ISs, juxtaposed with insights drawn from over six hours of interviews with the TAs and instructor, as well as my field notes from attending over 48 of the 52 hours of lecture across the two sections, 21 hours of discussion sections, and three weekly TA planning meetings.

Active Learning in Lectures and Discussion Section

Responses on individual post-course survey items indicate that on the whole the ISs had a positive outlook on active learning techniques employed during lectures. On a scale of one to five regarding the importance of these techniques for learning course content (one = "very unimportant," five = "very important"), ISs rated them between 3.8 and 4.4 (Table 6.1). Valued techniques included gesturing with hands (4.0/5) to act out concepts and explore complex processes, and playing Kahoot! (3.8/5). In response to items specifically focused on peer interaction, ISs reported that they typically spoke with neighbors when instructed to do so, and that they found these interactions important to their learning of the course material. ISs also ranked "answering clicker questions a 2nd time after talking to neighbors" as highly important to their learning.

Table 6.1 ISs' engagement in active learning techniques

Item	Mean	S.D.	N	Min	Max
Did you talk to a neighbor when instructed to do so? *(Never = 1, Rarely = 2, Sometimes = 3, Often = 4, All the time = 5)*	3.92	1.11	36	1	5
How important was ___ to your learning of the course material? *(1 = Very unimportant, 5 = Very important)*					
-interacting with neighbors in class	3.86	0.97	35	1	5
-answering clicker questions in class	4.37	0.81	35	2	5
-answering clicker questions a 2nd time after talking to neighbors	4.14	0.91	35	2	5
-Kahoot!	3.8	1.05	35	1	5
-gesturing with your hands to act out things	4.00	0.87	35	2	5

Note: These survey questions were optional; hence there are missing data for one IS who opted not to respond.

Further indication of ISs' general comfort with these active learning techniques comes from their responses to an open-ended survey question in which they were asked to identify which components of the course posed the greatest language-related challenges. Of the 25 students who responded to this question, only one focused on an active learning component: "talking with others."

Whole-Class Discussion

During lectures, one of the simplest and most frequent ways that the instructor departed from a traditional instructional format was by roaming the aisles wearing a microphone and posing questions or taking questions from students. According to self-report survey data, most ISs remained engaged for these portions of class, though nearly half used the occasion for multitasking. In answer to the multiple responses question, "When Dr. Sherman took questions from students, what did you do? (Check all that apply)" all 36 IS respondents selected "listen" and/or "take notes," though 16 of these respondents also selected "look at notes or other materials related to class" and/or "talk to a classmate," and three also selected "Do something unrelated to class (e.g., texting, Facebook, work for another class)." On a

separate survey item ("When Dr. Sherman took questions from students, how often did you pay close attention?"), only 14% responded that they did not typically pay *close* attention to these segments (i.e., one chose "Rarely," and four chose "Sometimes"). In other words, 56% of the ISs expressed that they did nothing other than listen and/or take notes during these discussions, and 86% indicated that they paid close attention at these times.

One further indication of ISs' engagement in these kinds of discussions comes from my field notes from the last day of class. On this occasion, the instructor finished his slides early and dedicated the rest of the session to taking questions from students, giving everyone the option of leaving early if they so desired. In the 12:00 section, I noted that over one hundred students opted to leave, among them eight of the ten ISs that I was tracking, including Yang. In the 1:00 section, however, far fewer students left overall, and of the nine ISs I was tracking, Harry was the only one I saw heading for the exits. One interpretation is that when it was socially acceptable to leave early, many of the ISs opted to do so.

In the interviews, ISs indicated that these discussions may have been particularly challenging for them. At these times, "Usually (the instructor) will repeat the questions, which is really good for international students because it's really hard for us to get ...because I am not good at listening," noted Maxine. Harry reported that even the paraphrasing was oftentimes insufficient. "It's not very easy to understand because students when they are asking questions they they are sound very not very loud and [the instructor] will repeat it and just it's not very um not very clear. Sometimes." He went on, "Because the questions is their questions and we don't just we just don't get the background about the questions …we need a little time to figure out the something about the question. So we just cannot understand it immediately."

In sum, though self-report survey data indicate that ISs were engaged during these periods of discussion, it appears that ISs may have faced difficulty following the discussions, and may thus have had a preference to do other things with their time, either by multitasking or by exiting early when given the chance.

Clickers and Talking to Peers

Highest rated of all the active learning techniques was the use of clickers (4.37/5 on a scale of importance). Clicker questions were posed several times during each class, in formats such as multiple choice, identify the true statements, and putting items in a sequence. Students were given roughly one minute to "click in" their responses, and a box on the screen provided a tally of how many responses had been received. As the number rose into the 300s (typically within one minute), the instructor would close the question and determine whether to move on or not.

In his interview, the instructor shared that "If I notice them, not answering it, the majority, correct, I'll say, 'Ok now talk to each other about it,' then repoll." That this practice, known as peer instruction, was effective became evident as soon as the instructor revealed the graphs of class responses for each iteration, with the responses routinely shifting toward the correct answer in the second instance.

ISs found these conversations and second "clicks" beneficial, rating them 4.14/5 on the scale of importance to their learning. When asked to describe this component, interviewees focused on general benefits. Gladys noted that the discussions allowed her to "get more information about the question," whereas others focused on the answers. As Harry observed:

> The first time [you click in] is your personal idea but the second clicker is [after] you chat your neighbor and then get a maybe you are right or they are right or you both get right answer or you both are wrong. During the chat you can get something you …may ignore when you are learn by yourself. And can improve …very well.

According to Maxine, these discussions between the repeated questions were:

> really important because you can get the right answers through it… after the first clicker questions and you have to discuss with each other and after that you have to choose again and if you could be wrong in the first time and after the discussion you figure out what is the right one and you can just put the right one the second time.

Yang typically benefited in just this fashion:

> **Interviewer:** So what is your experience. Do you find that when you click in a second time you change your answer or keep your answer the same?
> **Yang:** Often change the answer, because I think like those classmates who sit beside me when we discuss they always talk confident and I think their explanation is quite good so I often change my answer and the answer often turns out to be right. I think they also study hard on the material so I think I also learn a lot from them.

Another IS found that just as often he was the one influencing his partners in a positive fashion:

> **Interviewer:** What has your experience been when you talk to your neighbor and click in again, do you keep the same answer or change or what? What happens?
> **Harry:** Sometime I will change but sometime I will keep my answer I think. My answer is right and I try to figure out why my answer is right and why we should choose this questions this answer and something like that.
> **Interviewer:** Ok so when you talk to your neighbor sometimes you keep your answer. Does your neighbor ever change his answer or her answer after talking to you, do you know?
> **Harry:** Yeah, they will change.
> **Interviewer:** Yeah? So sometimes you will tell them your idea and your idea is actually the right answer.
> **Harry:** Yeah.

In Maxine's view, the benefit of these discussions depended on the quality of the interaction.

"It depends on if you do really discuss well with your partners."

Despite the ISs' apparent appreciation for these discussions, and their self-reports that they nearly always spoke to a neighbor when instructed to do so (3.92/5 on scale from one = "Never" to five = "All the time"), in my lecture field notes it was not entirely uncommon for me to observe at least one or two ISs who seemed to refrain from such participation during class, including two who had highlighted the value of talking to neighbors during the interviews.

IS interview data help clarify this circumstance. Whereas Gladys indicated that she was quite comfortable interacting with peers, the other three expressed that talking to neighbors was not always something that came easily. Harry commented that "the most interesting part of the class is chat with your neighbor," but added "Actually the first time I didn't like it because uh just I just don't like to talk with others and just like that." Elaborating on the awkwardness of such encounters, he said, "at first I just keep silence and my neighbor just keep silence and so we just don't talk to each other." Yang commented, "there is still a barrier between Chinese students and like foreign students, …like it is still awkward to just suddenly start a conversation between like people from two different countries especially like one speaks Chinese and one speaks English." Interestingly, despite this awkwardness, he expressed a preference for talking to English-speaking classmates.

Maxine expressed her reservations in terms of her personality, saying,

> I am the kind of person who do not really like to talk. Especially English. Especially to a stranger which I don't know before it? …with someone who I didn't know before it's hard for me to talk a lot.... But if I can talk with my friends, if we can sit together? …I will talk a lot.

Later in the same interview Maxine further underlined the importance of familiarity with peers:

> I haven't tried to answer the questions in [lecture] yet but I did in [TA] Julia's discussion because I think they are smaller groups of people in the discussion section rather than in the huge lecture. Because I will feel embarrassed if I say something wrong. Especially, English is my second language, sometimes people will laugh at your accent or your way to talk. And I know that because I also went to some other professor's lecture and I know that even for the local people if they say something wrong and people will laugh at them. … but [in discussion section] I think because I know that people there are nice people, they will not laugh at you, we are familiar with each other because they are just, like, thirty students. We know each- like, 30 students we are familiar with each other. We know that they will not laugh at you, so I will answer some questions.

This response demonstrates the impact that familiarity with one's peers could have on ISs' learning, and thus the potential value of the more intimate discussion sections.

Discussion Sections

Gaining familiarity with peers. Active learning in the discussion sections likely played a large role in students becoming familiar with their peers, as first sessions were largely dedicated to icebreakers and introductions, and cooperative learning in small groups was a constant throughout the quarter. Each of the IS interviewees said they had made friends in their discussion sections, with Harry drawing an explicit contrast with lectures, explaining, "Sometime we [meet friends] in the discussion and uh it's, it's rarely to meet them in lecture. There are so many people." Similarly, Yang shared that he liked the professor's teaching and the opportunity to make friends during the times to talk to neighbors during lecture, but when I asked about the friends he had made he shifted his focus to a girl he had met in the discussion section:

> We were put in the same study group. We taught each other questions we don't understand and she found that maybe I have some good points that I could help her and she also has something good to help. There are some questions that I don't know and she don't know and I could explain it clearer to

her and she have some questions that she know and I don't know and she could explain it to me.

Developing acquaintances with peers could be a pleasant side effect of active learning, and these relationships could in turn facilitate students' engagement in active learning. Survey responses indicate that 94% of ISs and 95% of EDSs had made one or more friends and acquaintances during the course, with 58% of ISs saying that the number was actually as high as three or more (Table 6.2). In addition, one IS survey respondent shared, "I love [the instructor's] course. This course not just let me learn about Biology, but let me intergrade [*sic*] into the big family-[the university]".

Table 6.2 Responses to "How many new friends or acquaintances did you get from attending Bio 101 lectures and discussion sections?"

# of friends	ISs	EDSs	Whole class, 1st years
0	2 (5.56%)	9 (4.76%)	38 (5.75%)
1-2	13 (36.11%)	41 (21.69%)	142 (21.48%)
3-4	10 (27.78%)	64 (33.86%)	230 (34.80%)
5-6	6 (16.67%)	32 (16.93%)	128 (19.36%)
7 or more	5 (13.89%)	43 (22.75%)	123 (18.61%)
Total	36	189	661

Note: "Whole class, 1st years" consists of all 1st year students who are not ISs and who are not missing data

Mixing into groups. Cooperative learning in the discussion sections typically consisted of the use of group worksheets and collaborative quizzes. For the worksheet tasks, TAs either randomly assigned students to new groups each week or allowed the students to self-select into their groups. If ISs were essentially reluctant to interact with peers, we might expect them to prefer working alone or, failing that, we might expect them to prefer to work with a group they could become familiar with. Indeed, as Table 6.3 shows, a higher percentage of ISs preferred to work alone (14%) than did their English-dominant (7%) and whole-class (5.5%)

peers. Yet 86% of ISs rejected working alone, with the largest percentage expressing the preference of working in different groups (47%) every week.

Table 6.3 Responses to "If you could take this class again, which option would you prefer for completing worksheets during discussion sections?"

	ISs	**EDSs**	**Whole class, 1st years**
Working in the same group of 3-4 students every week	14 (38.89%)	80 (42.55%)	262 (39.88%)
Working in a different group of 3-4 students every week	17 (47.22%)	95 (50.53%)	359 (54.64%)
Working alone	5 (13.89%)	13 (6.91%)	36 (5.48%)
Total	36	188	657

Note: "Whole class, 1st years" consists of all 1st year students who are not ISs and who are not missing data

Some TAs provided valuable contextual information during their interviews, as they shared that they were deliberate in the ways they implemented group work in order to facilitate students' participation. Because TA Susan wanted her students to get used to "communicating with everyone and not just the person they are sitting next to," and because she wanted to make sure that the students who "know what's going on" had the chance to "really teach or lead the others and not leave one or two behind," she made a point of randomly assigning students to groups, despite a tendency of the ISs to "often try to stick with each other." In my discussion section observations I saw that most other TAs did the same. TA Donna had the perspective that for ISs who were not socially integrated, such random assignment to groups "might be a little more comfortable for them" than letting students form groups on their own, "because they wouldn't have to go up and ask somebody to be in their group."

In their interviews, the ISs seemed to embrace mixing into groups. Yang explained that his:

> TA will shuffle because she wants us to try to learn how to explain things to different kind of people… It is good because if you are talking to the same person it's not about like, actually, it is a bit boring because you are talking to the same person. If you could talk to someone you may be able to learn from them and maybe you could find someone who is knowledgeable and they could help you. Like it gives you a chance to find someone who they could teach you or you could learn from.

Harry similarly shared that he thought that mixing into new groups was "great," as it allowed him to "talk to many different peoples," and Gladys explained that though this style of learning was not typical of her experience in China, she found it "more efficiency… I still can get more information from others and have if I don't understand some questions maybe they have a better answer and can explain to me."

Participating in discussion. For most of the class period, students had the freedom to participate within their worksheet groups as they chose. In the classes I observed, some groups spent almost the entire time working closely together, whereas other groups amounted to loosely connected individuals completing the worksheets mostly on their own, though members would break the silence at times to compare notes and get help.

In the next stage, TAs facilitated whole-class discussion of the answers. Donna noted that when she called on ISs to answer a question they typically used intonation or hedging indicative of a lack of confidence, correct though their answers often were. This may have been a common trait, as I noted similar behavior when Harry sat next to me in lecture the first time I saw him. During the occasions to talk to a neighbor, he often had answers that ultimately proved correct, but when he told me the reasoning behind his answers he would hedge, saying things like "but I don't know if that's right." This was despite the fact that when I interviewed

him later in the course he revealed a fair amount of confidence in his comprehension of the course content overall.

In her interactions with ISs, TA Susan found that giving "a moment to think about it or let them think and then come back later" would make a difference: "Then they know what's going on typically." Though this practice seemed to have an impact on ISs' accuracy and confidence, she added that this complicated her assessment of how they were doing in the class:

> So then at that point I don't know if they're nervous because they are just trying to answer me quickly or comprehend what I'm saying very quickly or if it's they don't actually know what the answer is. So then there's that that uncertain language barrier in there.

Taking the collaborative quiz. In the final phase of the typical discussion section routine, students were compelled to work cooperatively as they first had "five minutes on your own" to write answers on individual copies of the week's quiz "and then the rest of the time to talk with the group" to reach consensus and submit a single copy of the quiz for a shared grade, TA Donna recounted. She continued, "after the five minutes on your own I think [the ISs] worked on it just like everyone else but again just that lack of confidence in their answers even if they were right." She added,

> Also, when you would ask for everyone "Ok, now you can talk to each other working on the quiz," the international students I don't think were ever the ones to start the conversation. I think they'd wait for other people to be like "What'd you get on 4?"

Carla noticed the same thing with her shyest student, a student who would attend all TA office hours but never speak unless she were the only one to attend, but "toward the end of the quarter she got a little more confident and in the group she would be like 'Well I got this' and

then other people would be like 'Oh me too.' She initiated it." This display of confidence may have influenced the TA's perceptions of the student's engagement in the class, for she referred to other ISs in more negative terms, saying "But the other ones …they weren't, uh, they would just kinda sit back and let the other students do, do the work."

From Maxine's perspective, silence in group work was not so much a case of refraining from work as it was an expression of a preference to keep peace. However, the structure of the collaborative quizzes had the power to break through that inclination and facilitate the kind of active engagement that Carla's student came to demonstrate. As Maxine explained:

> Actually, because it's graded and if you want to get a better scores for your group you have to tell each other that why you choose this, why you have this answers for this questions… Actually, it's weird because for Chinese, we are the kind of people who don't like to argue with each other. I don't think argue is the right word, but we don't like to say that your answer is wrong, because mostly we like to just say, "Ok you put this, I will put that," but for the discussion we have to tell each other that we have different like opinions about the same questions. So in order to get a higher grade we have to try to review well and tell each other that why you are wrong, why I want to choose this. …I have to say something. Because if it's not graded, I would not say something, "Oh you are wrong, I am right." Yeah. Because I don't like to argue with each other. I don't think I have to use "argue" but I don't like to say, "Maybe you are wrong."

It seems collaborative activities of this nature could compel otherwise quiet ISs to gain experience debating content with peers. In addition to the obvious content learning benefits such engagement could yield, Maxine recognized a linguistic gain from this peer interaction, as she identified it as the main component of the course that helped her develop her speaking skills.

Weighing mandatory discussion sections against other options. Discussion sections were a common focus of legacy items held over from prior versions of the instructor's post-

course surveys. In their responses, ISs seemed to give them mixed reviews in terms of their value to their learning. Whereas 81% said they found the sessions important (Table 6.4), 50% preferred to have the independence to decide whether or not to attend, and two ISs shared that they would prefer not to have them at all (Table 6.5).

Table 6.4 Responses to "How important or unimportant were the discussion sections to your learning of the course material?"

	Frequency	**Percent**
Very Unimportant	1	2.78%
Unimportant	1	2.78%
Neither	5	13.89%
Important	15	41.67%
Very Important	14	38.89%
Total	36	100.00%

Table 6.5 Responses to "If you could take this class again, which option would you prefer?"

	ISs	**EDSs**	**Whole class, 1st years**
No discussion sections	2 (5.56%)	8 (4.23%)	29 (4.39%)
Optional discussion sections	18 (50.00%)	94 (49.74%)	325 (49.17%)
Required discussion sections	16 (44.44%)	87 (46.03%)	307 (46.44%)
Total	36	189	661

Note: "Whole class, 1st years" consists of all 1st year students who are not ISs and who are not missing data

Other questions asked students to weigh the value of these discussion sections in comparison to the value of other means of understanding the content, and the ISs' answers revealed that for them, discussion sections placed relatively low among the plethora of options, though not at the bottom. In comparison to optional face-to-face means of learning the content (professor office hours, TA office hours, and peer tutor office hours), more ISs chose discussion sections (n = 14) as most important to their learning than anything else, but Table 6.6 shows that when ISs were asked to choose between discussion sections, in-class lessons, and three non-face-to-face options (textbook alone, textbook + reading guide, and *Mastering Biology*),

none chose discussion sections, and 83% chose non-face-to-face options, which included 58% who chose the textbook/reading guide combo as most important.

Table 6.6 Responses to "What was the most useful part of the class in terms of learning the course material? Select one."

Course component	**ISs**	**EDSs**	**Whole class, 1st years**
Textbook Alone	3 (8.33%)	8 (4.23%)	19 (2.87%)
Textbook + Reading Guide	21 (58.33%)	98 (51.85%)	370 (55.98%)
In-Class Lessons	6 (16.67%)	47 (24.87%)	144 (21.79%)
Mastering Biology	6 (16.67%)	24 (12.70%)	95 (14.37%)
Discussion Section	0 (0.0%)	12 (6.35%)	33 (4.99%)
Total	36	189	661

Note: "Whole class, 1st years" consists of all 1st year students who are not ISs and who are not missing data

In addition, another set of questions approached this topic in reverse by asking the students to rate how they would have done in the course if they did *not* have a particular course component, and in that instance ISs gave discussion sections the weakest response of the six options: Only 19 out of 36, or 53%, said they would have done "A little worse" or "A lot worse" without discussion sections, whereas more ISs said they would have done worse without the textbook (78%), lectures (75%), reading guides (72%), pre-class assignments (78%), and weekly quizzes (63%).

The topic of ISs' experiences with TAs and discussion sections will be revisited in the next two chapters, complicating the picture somewhat. As we shall see, though ISs may have had some legitimate reasons for reservations about the sections, they also may have benefited more than they realized.

Metacognitive Course Components

Students' metacognition, or thinking about their own learning, is said to be an important way of linking the activity and learning components of active learning (Brame, 2016), and

explicit attention to metacognition may hold the secret to effective pedagogies of active learning (Tanner, 2012), helping students engage in the higher order thinking that active learning is best suited to (Freeman et al., 2011). Among other things, metacognition can help secure the benefits of active learning as it enlists students in monitoring whether their ways of engaging are effective. Several components of the course promoted such metacognition, inviting students to think about their thinking, and to improve their study habits as a result. However, these components of the course did not seem to hold as much value for the ISs as other aspects of the course.

Learning Objectives and Bloom's Taxonomy

The course syllabus stated that an understanding of learning objectives was essential to success in the course, so that students would "be able to tell whether or not you really know the material" (Figure 6.1).

Learning Objectives: In order to do well in this course, you will need to know exactly what I want you to be able to, and this is where learning objectives come in. At the beginning of every day of class and in the course schedule below, you will be presented with learning objectives that clearly state what I expect you to be able to do. For example, "At the end of this class session, you will be able to compare and contrast the male and female reproductive systems." Learning objectives are things that you can actually DO, so you will be able to tell whether or not you really know the material. Learning objectives come in all levels, from the very basic to the very complex (see Bloom's Taxonomy below), and you will be challenged at all levels in this course.

Tip # 2: *Make sure that you can actually DO each learning objective – these are the keys to doing well in the course!*

Bloom's Taxonomy: Memorization is important – you can't describe biology without knowing biological definitions – but to do well in this course you will have to use the information you have learned to solve problems in new and different ways and to evaluate and weigh multiple solutions to a problem. To test your ability at these different levels of thinking, I will rely on the structure of Bloom's Taxonomy, a system used to classify levels of knowledge, from lower-level (remembering, understanding) to higher-level (applying, analyzing, evaluating, and creating). Throughout this course, you will be exposed to the levels of learning described by Bloom's Taxonomy and also will be challenged on exams and in class to solve problems at all levels. Learning objectives (see above) and questions can be categorized at different Bloom's levels, so as we go through class you will get a feeling for what an "understanding" question is versus an "analyzing" question. I will not simply ask you to memorize facts and regurgitate them on exams; rather, I expect you to be able to think critically and to apply and analyze biology in new and interesting ways. Learning to solve higher-level problems will not only help you succeed in this course, but in your other courses as well.

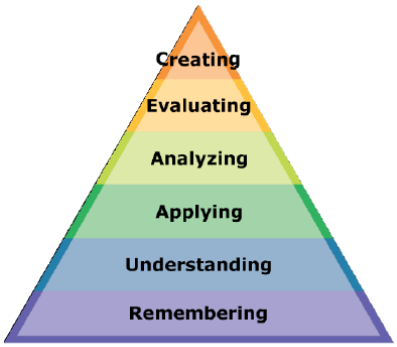


Figure 6.1. Syllabus excerpt: Learning objectives and Bloom's Taxonomy.

The instructor underscored the importance of these learning objectives and levels on Bloom's Taxonomy throughout the quarter, dedicating part of the first day of class to discussing them (Figure 6.2), and working them into each of his PowerPoints in two major ways. Within the first few slides he always included one that listed and numbered the day's objectives. Subsequent slides that connected with these objectives were annotated with the objective number in a circle, and slides with questions or problems were marked with numbered triangles corresponding with one of three levels on Bloom's Taxonomy, depending on the nature of the task. In addition to imbuing the lessons with transparency, the provision of this information promoted metacognition as it invited students to think about their thinking, asking

themselves if they were meeting objectives and performing at the appropriate levels of Bloom's Taxonomy.

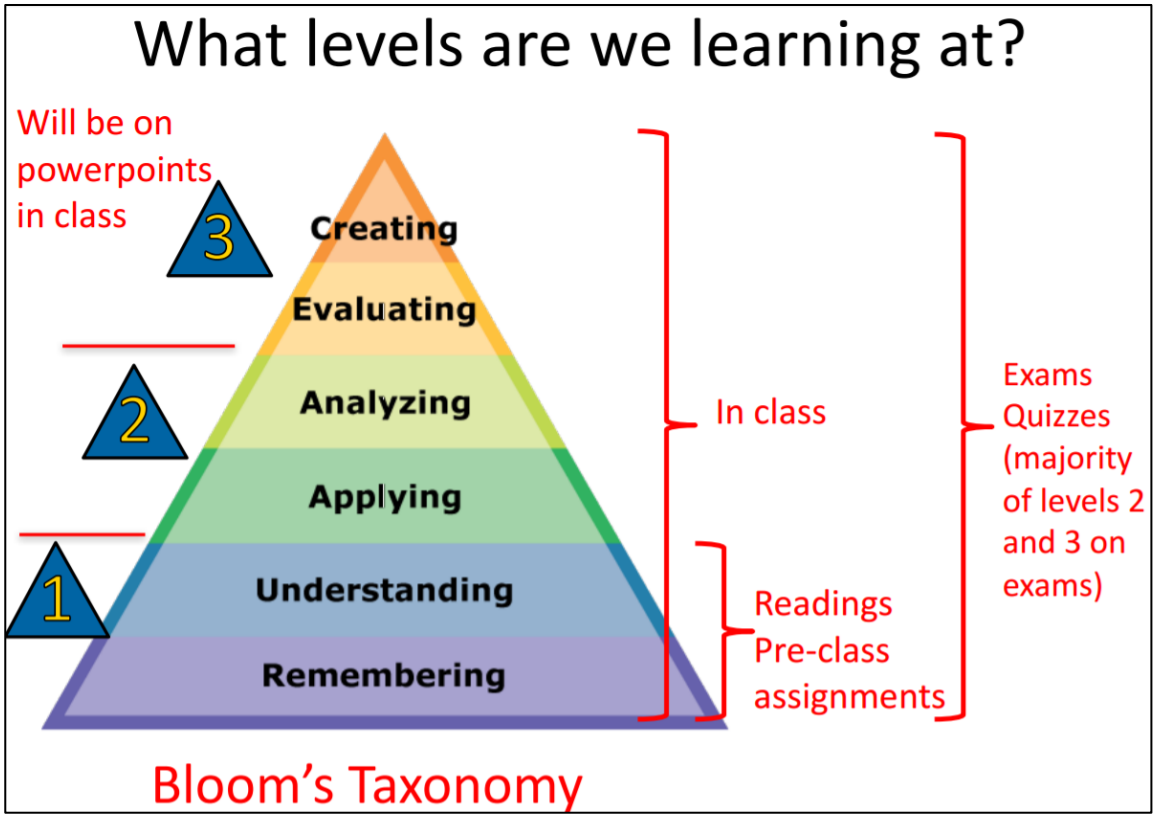


Figure 6.2. Course connection to Bloom's Taxonomy. Slide from first day of class.

ISs' survey responses indicated that 69% found the Bloom's Taxonomy numbers on the slides important, and 80% found the objectives numbers important (Table 6.7). When I discussed these components with ISs during interviews, I showed them a slide from class with the numbers on it and asked them to tell me about it. For two of the interviewees, the numbers made no contribution to their understanding, but also did no harm. Harry responded, "Actually I didn't notice that… I don't know, maybe it's relevant to the book – textbook… Or just relevant to the schedule, syllabus," and Gladys said, "Actually I don't know… Maybe it's a question number… Is this a chapter number? … I never think about this."

Table 6.7 Importance of metacognitive course components

	Study skills workshop	**Bloom's Taxonomy #s**	**Objectives #s**
Did not use/attend	6 (16.67%)	0 (0.00%)	1 (2.86%)
Very Unimportant	1 (2.78%)	1 (2.78%)	0 (0.00%)
Unimportant	1 (2.78%)	0 (0.00%)	1 (2.86%)
Neither	8 (22.22%)	10 (27.78%)	5 (14.29%)
Important	7 (19.44%)	16 (44.44%)	9 (25.71%)
Very Important	13 (26.11%)	9 (25.00%)	19 (54.29%)
Total	36 (100.00%)	36 (100.00%)	35 (100.00%)

Yang, on the other hand, recognized the numbers in circles as learning objectives, saying:

> Like this is learning objective something, like 17.1. and then he would explain fundamentals and said he covered it so we should know it even though the question is hard, it comes from the basics. So yes, it is to remind us where we should go back to check if we don't understand this question.

In his description, Yang touched on the instructor's purpose as stated in the syllabus, of facilitating students' reflection on whether they really knew the material and were able to *do* the things described in the objective, but Yang seemed to focus more on the fact that these numbers made it possible for students to tailor their review to the areas where they needed the most work. However, Yang's awareness of this aspect did not seem to result in any refinement of his study habits: "I don't really flip back [to look at particular objectives], like I always study like from the whole chapter from the start when I review."

Unlike Harry and Gladys, both Yang and Maxine were able to describe the course connections to Bloom's Taxonomy, without my giving any prompt other than asking them about the numbers in triangles. Maxine explained that these numbers represented "the level of the knowledge you need to know," beginning with a base level of memorization and going to a second level in which "you have to know how to apply it and how to use that in some

questions," and going up to "one which is really important but also difficult is that you have to try to think in a scientific way, which means that you have to like think as a scientist."

Yang's account demonstrated that he was well versed in both Bloom's Taxonomy and the instructor's ways of using it, though he described it with more levels and he seemed to talk about the hierarchy with the numbers reversed from the way Maxine described it:

> It is like the six levels of thinking. Six is the lowest level, which is memorizing and one is like analyzing or applying it to your life. And he marks those question like through those levels like maybe this question will be level six or something, maybe some would be one or two, which is more challenging for us. And he said to us in our quiz the questions all fall in one and two. He wants us to analyze more and think more like a biologist. …Like memorizing is like you are not really applying the knowledge you are just memorizing instead of understanding the meaning of it, like level one and two is when you really apply and analyze those knowledge and make it for your own, and turn it into your own knowledge.

In sum, though the objectives numbers seemed to hold only limited value for the ISs I interviewed, for some the Bloom's Taxonomy focus seemed to resonate, driving home the point that effectively learning the content required active engagement beyond rote memorization.

Study Skills Workshop

The instructor's provision of such meta information as learning objectives and Bloom's Taxonomy levels was in keeping with his investment in developing students' metacognitive skills, which included a full class dedicated to a "study skills workshop" one week after the first midterm. In this session, the instructor posed questions regarding the way the students studied and how prepared they had felt for the exam. He made the case for students to eschew simply re-reading the book in favor of testing their knowledge through practice problems, and he

encouraged them to develop their metacognition – "know what you know and what you don't know."

Table 6.8 Whole-class clicker responses from study skills workshop

How many hours did you study for exam 1?	**A. 0 to 2**	**B. 3-5**	**C. 6-8**	**D. 9-12**	**E. More than 12**
Class A	0%	5%	24%	30%	25%
Class B	4%	21%	34%	26%	19%

When did you start studying for the exam?	**A. Didn't study**	**B. Day before**	**C. 2 days before**	**D. 3 days before**	**E. 4 or more days before**
Class A	2%	9%	18%	24%	48%
Class B	2%	10%	20%	21%	48%

Note: In each instance, the instructor turned off the clicker tally shortly after he had received 370 responses.

Although only 46% of ISs expressed that they found this session important/very important (Table 6.7), one interviewee indicated that the study practices poll conducted during the session had impacted her thinking about her own habits (Table 6.8). Gladys said she remembered "most students spend, uh, maybe four hours per day to prepare for an examination, and actually in the first exam I just spent about one hour or two hours a day to revise, and it's really inspired me to study harder." As a result, she reported that it led her to get "a high score" on her second exam. However, two other interviewees shared that this poll had little impact. Harry commented, "I just a little surprised that so many people spent a lot of time, so many time on the middle exam… I just, I just did the practice exam and just read the book (*laughs*) just … maybe not really hard working."

Maxine seemed to indicate that the poll was not relevant to her. "To be honest, I study hard. I know that because usually I will spend like three hours per day." As she expanded on the topic, she saw a connection to her view of Chinese culture:

> But I didn't really put that I study so much because I don't know. Maybe for just the Chinese we just don't like to show something like, "Oh, I study real hard." That's our identical personalities? Have you heard that if you compliment someone, we just will say something like, "Oh no, I am not smarter than you, I am just normal." We say, "I'm not that smart, you're smarter than me." I know that in U.S. we have to say, "Oh, thank you."

In this fashion, Maxine suggested that such direct discussion of study habits could be complicated for Chinese students like her, as they might not find it culturally appropriate to speak out about their hard work.

High Structure Course Components

In the first of several paragraphs in the syllabus about course structure and components, the instructor underscored the way that the course was designed to keep students on track toward learning the content and getting good grades, and how this was an active pursuit:

> This is a "high structure" course meaning that you will have many opportunities to succeed and to be an active participant in your learning. You will have daily pre-class reading and online assignments, in-class activities and practice questions, and weekly review quizzes. While this sounds like a lot of work, the course is set up this way because we know from educational research that high structure courses lead to improved student learning and retention (and that means higher grades too!).

With this paragraph the instructor demonstrated that his definition of high structure was similar to the one used in research literature on active learning, as it involved helping students prepare for class, having regular low stakes assessments, and helping students prepare for the exam by asking them questions that require the same kinds of higher order thinking that they would need for final assessments (Freeman et al., 2011; Freeman et al., 2007; Haak et al., 2011). As noted in Table 6.1 above, students rated these clicker questions as the most

important of all the active learning practices for their learning of the content (4.37/5 on a scale from unimportant to very important), and they similarly rated answering questions a second time after peer discussion highly (4.14/5).

Table 6.9 Importance of high structure course components

	MB pre-class assignments	**MB weekly quiz**
Did not use/attend	2 (5.56%)	2 (5.56%)
Very Unimportant	0 (0.00%)	0 (0.00%
Unimportant	1 (2.78%)	1 (2.78%)
Neither	1 (2.78%)	1 (2.78%)
Important	6 (16.67%)	10 (27.78%)
Very Important	26 (72.22%)	22 (61.11%)
Total	36 (100.00%)	36 (100.00%)

ISs' responses to other survey questions on the high structure course design revealed that they had great appreciation for the other components as well, as 89% of ISs found both the pre-class assignments and weekly quizzes important or very important to their learning of the content (Table 6.9). IS interviewees reinforced this finding, as Maxine reported that she dedicated great amounts of time (and lost sleep as a result) to working on pre-class assignments, and Gladys and Harry reported that these assignments were foundational to their exam preparation. In Harry's case, these pre-class assignments might have worked a little too well, as he said they were the cause of his uncommon behavior of not taking notes and not even bringing a copy of the slides in any form: "Actually I found out that the lectures, some key points of the lectures, is totally the same as I learned from the textbook or the pre-class assignment, so I think it's not necessary."

In this fashion, Harry expressed that the pre-class assignments more than prepared him for class. To an extent, this seems to align with the instructor's rationale behind the

assignments, as he stated, “Students ideally come to class prepared by doing a pre-class reading guide that is optional, that I made to help them read through the textbook. And also they do a pre-class activity on our online system *Mastering Biology*, and then when they get to class …we can hit the ground running.”

From these statements we see that one of the reasons high structure course design may be so crucial to the success of an active learning course like this one is that it pushes much of the content learning into students’ out-of-class time, reducing pressure on the instructor to “cover” all the material, and thus creating the space for interactive activities and discussion. To help make sure that the biology students were able to complete the necessary preparation for these class sessions, the instructor and TAs offered various forms of online and face-to-face support for students to access outside of class. These offerings may have been of particular importance to ISs, for although they seemed to value the active learning components of the course, their participation seemed to be impacted in various ways by their comfort with English as an L2. In the next chapter I turn to these offerings to see if and how the ISs made use of them to help them meet the demands of this high structure active learning course.

Chapter Seven: ISs' Use of Course Resources and Components

In addition to the use of active learning techniques during lecture sessions, and as a further part of the effort to increase students' persistence, the course differed from a traditional instructor-centered lecture format through other unique components, including its provision of a broad range of options for support outside of class (Figure 7.1). Given the "high structure" nature of the course, which required students to do much of the content learning in their own time, these options may have been important for all of the students, and they may have been essential for those facing the added challenge of learning the content through English as a second language. In this chapter I investigate ISs' choices and behaviors with regard to these resources, seeking answers to the fourth research question, "What resources and components of the course do ISs use to support their content learning in this context of active learning? What are ISs' perspectives on the utility of these resources and components?"

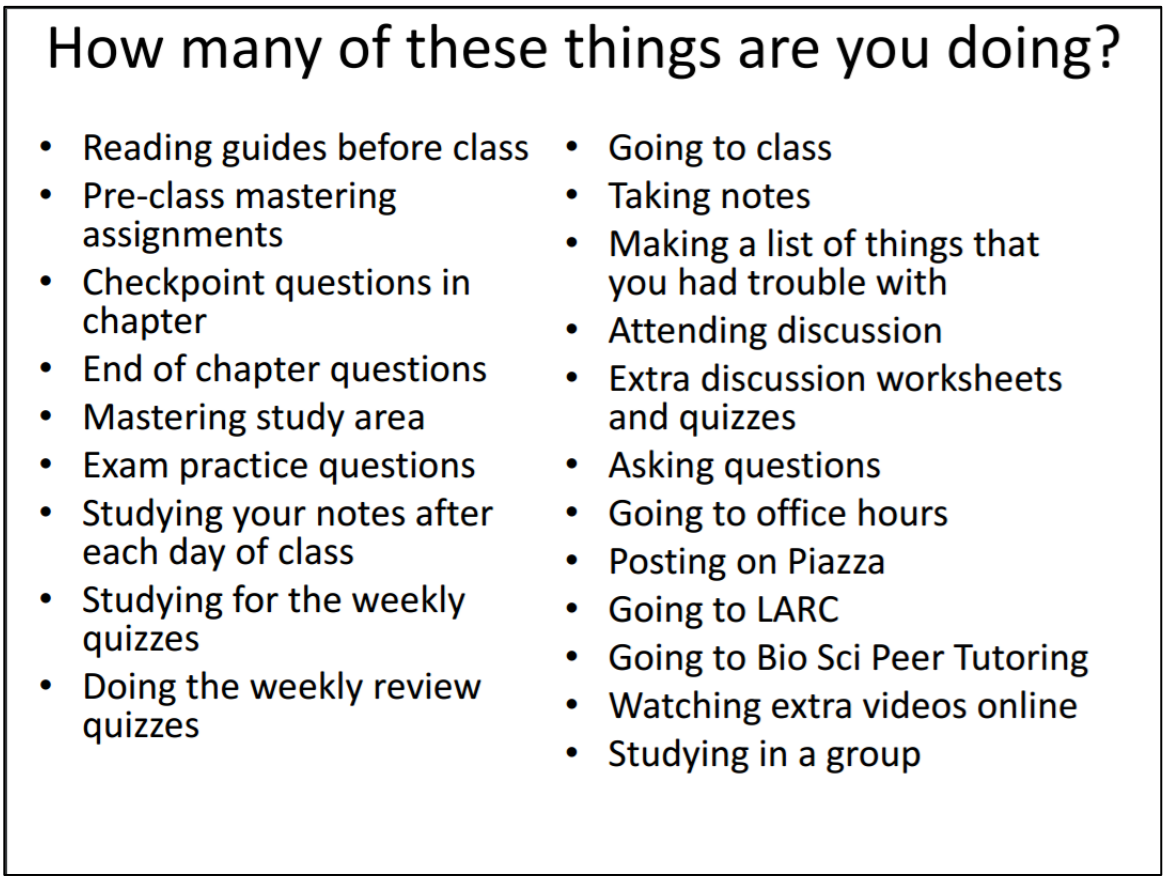


Figure 7.1. Options for learning course content. Slide from "study skills workshop" class.

Face-to-face options included peer tutoring, as well as such traditional offerings as instructor and TA office hours, whereas non-face-to-face options included an online question and answer platform called Piazza, podcasts of the instructor's lectures, and a number of online resources associated with the platform for the students' weekly assignments, *Mastering Biology*. Among the resources offered on *Mastering Biology* were practice quizzes and tests, biology videos, adaptive follow up assignments, and dynamic study modules.

Face-to-Face Support

Lack of participation. According to self-report survey response data, 14 of 35 IS survey respondents never attended any form of optional face-to-face support. Various reasons for this

lack of participation are suggested in the survey and interview data, including preferences for seeking help from friends or working alone, and lack of time.

Although Harry and Gladys explained their lack of attendance to any face-to-face sessions in terms of their 'laziness,' other portions of their interviews suggested that they preferred to rely on peers. For instance, in one part of his interview Harry explained,

> I think I just not well prepared for the college life, because this is the first year for me. I just not very, you know, just sometime I just want some, I just want to have fun. I want to have a rest and something like that.

However, other parts of Harry's interview suggest that he did not necessarily need to attend office hours, because the social media app WeChat gave him access to a network of Chinese peers who were attending the same course and who could answer his questions (as will be discussed in greater detail below). Similarly, one survey respondent explained not attending these sessions because it was not necessary, as the student had "a study group which is helpful." In addition, Gladys also indicated a preference for help-seeking within her personal network:

> I think if I, uh, if I think I study well, I maybe won't go to the office hour, but if I have questions which my friends and my partners couldn't help me to understand better, I maybe go to office hour, talk to my TA or professor to get a better answer.

An additional reason ISs opted not to participate in such offerings was related to time as a limited resource. There were seven students who invoked this reason in various survey responses, saying things like "I think the course material costs a lot of time," and two expressed a preference to study alone.

Analysis of data related to peer tutoring, TA office hours, and instructor office hours can further illuminate ISs' ways of engaging in an active learning introductory biology course of this nature, and the kinds of support they find useful (or not).

Peer tutoring. According to the survey responses, those ISs who opted to partake in face-to-face formats of instructional support were most likely to choose peer tutoring (17 total, including 13 attending 1-3 times, and four attending five times or more) and least likely to attend the instructor's office hours (ten total, including six attending 1-3 times, and four attending five times or more) (Table 7.1).

Table 7.1 ISs' frequency of participating in face-to-face support options

Frequency	Peer tutoring	Instructor office hrs	TA office hrs
Never	18 (51.43%)	25 (71.43%)	21 (61.76%)
1x Per Quarter (once)	8 (22.86%)	5 (14.29%)	7 (20.59%)
1x Per Month (three times)	5 (14.29%)	1 (2.86%)	1 (2.94%)
1x Biweekly (5 times)	2 (5.71%)	1 (2.86%)	3 (8.82%)
1x Per Week (10 times)	1 (2.86%)	2 (5.71%)	1 (2.94%)
2x or more per week (20+ times)	1 (2.86%)	1 (2.86%)	1 (2.94%)
Total	35	35	34

Other survey questions gauged the value that students placed on each of these support options ("How valuable were each of the following types of sessions towards helping you learn the course material in Bio Sci 93?" on a scale of one, "not very valuable" to five, "very valuable") followed by the open-ended "Please explain your reasoning." Of the 16 ISs who found peer tutoring valuable/very valuable, not all gave comments, but three of those who did comment made mention of test preparation, saying they "enjoyed" the "really helpful" review sessions and that peer tutors "go over many points about tests," whereas two others generally mentioned that peer tutors "help me practice a lot" and "it is valuable because it helps me

learn." Three students found this offering not valuable, with two providing comments that referred to time as a limited commodity, as described above.

TA office hours. Regarding the TAs' office hours, eight ISs reported that they went and that they found them valuable/very valuable. In follow-up survey comments, several remarked on the TAs' capacity to "explain the material clearly and very fast," as well as appreciating their patience and good advice. Most neutral or "not valuable" commenters simply said they had not attended these office hours, but one respondent said, "They make me more confused. I got a problem worng [*sic*] because of them." Though this was not Maxine's response, Maxine found this to be a recurring concern. She explained that she attended multiple office hours in pursuit of answers to pre-test practice questions, because she felt asking all of the questions of one person would be too much. However,

> Some of [the TAs] are not pretty sure about the answer, just like me. And some of them, because [the instructor] never release the answer sheets, they probably will give you the wrong ones, which gonna make you feel really confused. Especially before the midterm, you will feel anxious and if you feel, "Oh, I get everything wrong," but actually you didn't. Just the person who tell you this answers, they, they are wrong. …You know that sometimes even the TA or peer tutoring they will make mistakes. …and maybe sometimes after I tell them that [the instructor] tell me that "the answer is this" and I want her to explain it one more time, because I didn't get it during the office hour, and she will try to get the right answer in a wrong way, which mean that she explained completely wrong, in a wrong way.

According to the instructor, not all graduate student TAs were experienced at teaching, and several did not specialize in biology themselves. That being the case, these kinds of errors are not completely a surprise, and perhaps the relatively mild appreciation ISs showed for discussion sections in the previous chapter is also understandable.

The fourth interviewee, Yang, did not describe encountering wrong answers, but he did mention other drawbacks of seeking help from TAs in his experience of attempting to talk to his TA immediately after class:

> Actually, when I ask questions, there is always a girl who is in front of me, and she really asks questions so long that I don't have time to ask, and when it's my time to ask like [the TA] is really, he is nervous. Because he has, there's, the next class is ready to begin, and she has to take her, she has limited time to answer my question, and she would speak very fast and her tone would be a little bit demanding or something, so I don't really know what I want to say, because when I want to ask a question, like, there will always be that girl who is in front of me and she spends all the time asking questions and I don't have time to ask, and I just stand there wait, and I wait, and I wait, and time just passes.

Of note, Yang's account touches on the theme identified in other students' survey responses, the idea of time as a limited resource ("I just stand there wait, and I wait, and I wait, and time just passes"). In addition, his experience provides insight into why some ISs may have preferred non-face-to-face options (Table 6.6), as those sources of help would not pose the risk of such social discomfort as that which could be caused by a TA's impatience or demanding tone.

TAs noted that few ISs seemed to attend their office hours, with one exception. Carla recalled a student who attended virtually every week, but who seemed reluctant to participate:

> She would just come and sit. Every once in a while, she'd have a question about the homework or like one of the pre-class assignments that Dr. Sherman would assign. But most of the time she would let the other students in the office hour kind of lead. And she would just be listening. But she was always there, every week (laughs). Besides maybe the first week… If she was the only one there, she would talk to me, and she would ask me questions. But if she was, if there was two or more other students there, even if I asked her directly if she had a question, she would never say anything. So I think, you know, that might have just been her personality, or, I wasn't sure.

Carla's student's ways of engaging (or not) in the office hours calls to mind Yang's account of the social discomfort he experienced in his post-class interaction with his TA, and Maxine's reluctance to speak publicly unless she felt sure she would not be ridiculed, all suggesting that Carla's student's tendency to remain silent might have been a result of something more than "just … her personality."

Instructor office hours. Fewer ISs attended the instructor's office hours than any other form of face-to-face support. Although six ISs reported that they attended one- to three- times and four attended five times or more, 25 out of 35 IS survey respondents reported that they never attended (Table 7.1). Three of those who attended the office hours expressed that they were the most valuable of any kind of face-to-face support, making such comments as, "We can ask professor question directly" and "…Professor's office hours was the best i could trust into and ask specific questions about the material… Professor has all the correct answers." Other open-ended survey responses reveal the perception that these office hours allow access to the unique insights the professor could provide, saying things like "It is important to speak directly to professor," and "it is valuable because it's direct information from the one who makes the test." Still, most ISs did not report attending the instructor's office hours very frequently, and on the last day of class, when the instructor reserved the last part of class for optional office hour-style question and answer, I watched a number of ISs head for the exits, along with a number of EDSs, as noted in the previous chapter.

Two ISs hinted at scheduling issues as impacting their participation, saying "[the instructor's] lecture is valuable but always overlap with my classes. That's frustrating," and "I never got a chance to attend," whereas one expressed the sessions were not valuable "Because

I am not good at show my own feeling." One interpretation of this statement is that it may have been a reference to the instructor's tendency to ask students to engage with material at higher levels of Bloom's Taxonomy, a practice that may have been unfamiliar to many ISs, as well as to local EDSs who were more accustomed to a rote memorization approach to biology in their high schools. Maxine's description of office hours made mention of such a practice: "He will answer some questions which you are confused about and he will give the answers after you guys discussed and you tell him what do you think about this and he will tell you this is right or not but he will never tell the whole answer sheet."

In his interview, Yang shared other reasons for not attending the instructor's office hours:

> …because it's like too crowded, and like I don't get a chance to ask my question because when you go there there's like 17 students, like he is too popular or something. But some said, "Oh I will go to his office hours once because it is really good. It is different if you learn individually by the teacher teaching."

Maxine described her visits to the office hours in similar terms, saying, "His office hour are really popular and it feels the same in lecture, yeah, so it's hard for me to talk in front of so many people in his office hour." Two other ISs expressed parallel concerns in their survey responses, saying "It is valuable but too many students," and "I have never been to any professor office hours because I think there are always many people and I am afraid to talk to my professor since he won't even remember me."

Importance of approachability. One factor that may have influenced students' willingness to attend these face-to-face support options is the perceived approachability of the instructor, TA, or peer tutor who was offering their time. Considering the fact that the students

had little chance of getting to know the instructor on a one-to-one basis in a class with hundreds of students, and also given that the gaps in age and expertise would be greatest between the students and the instructor, it might be expected that ISs would find him the least approachable of the three. Indeed, in responses to a survey question on this topic the instructor ranked last, but what is perhaps most notable is that the differences in approachability responses were slight (Table 7.2).

Table 7.2 Responses to "How approachable were the instructors of each of the following types of sessions?"

	Not very approachable	Very approachable	Total
Instructor office hours	9 (29.03%)	22 (70.97%)	31
TA office hours	8 (25.81%)	23 (74.19%)	31
Peer tutor	7 (22.58%)	24 (77.42%)	31

It seems likely that the instructor's teaching practices may have played a role in increasing his approachability, as he reported making deliberate efforts in this area. For instance, the instructor described his practice of moving up and down the aisles throughout the class in terms of approachability:

> …it's just about trying to create more of an interaction, more interactive feeling with the students that I'm not this omnipotent person at the front that is restricted from them or different from them or better than them or whatever. It's more like, "Hey I wanna walk around and listen in on what you guys are doing and let you see me up close," you know, and kinda reduce that barrier if there is one of feeling, if they view me as a person of authority. "I'm just a regular person too, you know. It's ok I'm close with you." I don't, though, lean in and like poke them and say "Hey whaddayou think?" I used to do that sometimes. I never felt comfortable doing it, it just isn't my style, so I just like to walk and listen.

IS interviewees noticed these kinds of efforts. Though Yang expressed reluctance to attend the instructor office hours, he held a favorable impression of the instructor's way of beginning class

with informal comments about topics like baseball or television or other things unrelated to biology class. Yang described this opening as follows:

> **Yang:** Like how do you say. Make students feel relaxed like because when we come to class like we also come back from holiday or something and he wants us like to study, relax, and be prepared for the class. I think so. Also makes the atmosphere relaxed or something, and also like he makes himself more approachable to students, like he is not a professor who just talks about things in his field. He would also talk about things that, like normal college students would talk about, like maybe the things they are interested in, like, or their personal private things, yes.
> **Interviewer:** Ok, does that work for you? Do you find that he's more approachable because he talks that way?
> **Yang:** Yes.

Maxine shared similar impressions, expressing great appreciation for the instructor's comments about his family, saying:

> Actually, I am really interested about it. Because I thought Professor Sherman is really young. I never know that he is already married and he have two children, so, that's not something which are related to academic studying but that's really interesting. It can help you to know the professor. They are also a human. They are not something like, uhhh, you can never feel like, because you know they know everything, they know everything about which you, you need to know for the test, and some of the students will feel scared because you never know that if he will trick you in the next final or midterm.

Still, Maxine also noted that comments by another professor about local dramas left ISs confused, and the biology instructor's comments on baseball made no impression on her due to her unfamiliarity with the sport. The other two interviewees had little to say about these asides and jokes – Harry said he didn't know what kind of things the instructor made jokes about at the start of class, and Gladys stated, "sometimes I think he share some things in his life about, uh, actually sometimes I didn't get the point why others are laughing." It seems that these

apparent efforts to build rapport might prove alienating to students who are left out of the joke.

Yang noted another aspect of the instructor's efforts to "Lower the barrier between professor and students, like make him more approachable, I think so": He regularly asked the students who spoke in class for their names. According to the instructor, this practice is something that is frequently recognized on the students' evaluations of the course:

> I tend to get comments about the names and caring. They tend to say it feels like I care. And they tend to throw in things like "unlike other professors," um, so, I enjoy and feel good about seeing that because I do care, it's the main part of my job is teaching and I really enjoy teaching, and I really do want them to do well. So I do care in that respect, and, using their names, they say they like that because "It feels like he's actually trying to get to know us," things like that, and they do mention a lot about the interactions and being engaged, and not being bored, and "It helps me learn because I'm so engaged."

In the instructor's terms, this use of names was indeed intended as a means of reducing the distance between teacher and student, and between student and student:

> You know, like when I was in college I don't remember, in larger classes especially, people calling your names and it just felt very arbitrary almost or very disconnected. And as an individual you kind of feel like "Oh, I'm just a number they don't even know me." But I try to use names, and I feel like it does create more of a sense of community in a large classroom, and it makes the class get a little bit smaller. And it helps the students get to know each other a little bit too in a way. So, I just feel like it creates a better environment, it's a little more friendly, a little more inclusive for learning in that respect.

Still, this use of students' names might have little value for making the ISs more comfortable interacting with the instructor outside class, as the instructor would rarely have the chance to learn the ISs' names. As he noted, "I don't feel like they answer questions that much. …you think about the students that answer, they're a much lower percentage that actually

participate, in class, I'd say, compared to their American peers," and besides, "I feel like they didn't come to office hours as much either."

Having smaller class sizes meant that the TAs would have a better chance of getting to know their students, and the instructor encouraged the TAs to learn their students' names. One TA shared that doing so may have had an impact on her own approachability, perhaps particularly with regard to this population. After learning the name of a "shy" IS, Donna later encountered her outside class, in an interaction she would not have expected:

> I was surprised one day walking to class I saw her and she was with her international friends and she like waved and smiled at me, which I was so surprised at, because she had just been so shy and unexpressive in class.

Non-Face-to-Face Resources and Support

In addition to the three main face-to-face opportunities for support, students had a number of non-face-to-face options to choose among, including Piazza, an online question and answer platform, podcasts of the instructor's lectures, and several online resources associated with the platform for the students' weekly assignments, *Mastering Biology*. These resources included practice quizzes and tests, biology videos, adaptive follow up assignments, and dynamic study modules. ISs made use of the full range of these offerings, to varying extents.

ISs' responses to questions about the importance of essential, traditional components of the course provide a means of gauging the relative importance these students placed on the supplementary offerings (Table 7.3). Responses to survey items on the importance of the textbook, lectures, studying for the exam, and working in discussion sections show that 81%-92% of the ISs found these components important or very important to their learning of the content. In contrast, 58%-67% found such optional/supplementary course components as

podcasts (67%) and optional features of the *Mastering Biology* website (58%, 61%) important/very important (Table 7.4). Though markedly lower, these rankings are within close range of the value ISs placed on the supplementary face-to-face options for support, office hours (56%) and peer tutoring (60%) (Table 7.5). Though it is not surprising that none of these optional support offerings supplanted the essential components of the course in importance, it is notable that all were valued by more than half of the ISs.

Table 7.3 Importance of traditional course components

	Textbook	**Studying for exam**	**Listening to lecture**	**Discussion sections**
Did not use/attend	2 (5.56%)	4 (11.43%)	1 (2.78%)	0 (0.00%)
Very unimportant	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (2.78%)
Unimportant	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (2.78%)
Neither	1 (2.78%)	2 (5.71%)	3 (8.33%)	5 (13.89%)
Important	5 (13.89%)	4 (11.43%)	7 (19.44%)	15 (41.67%)
Very important	28 (77.78%)	25 (71.43%)	25 (69.44%)	14 (38.89%)
Total	36 (100.00%)	35 (100.00%)	36 (100.00%)	36 (100.00%)

Table 7.4 Importance of optional online course components

	Podcasts	**MB study area**	**MB follow-up assignments**
Did not use/attend	6 (16.67%)	5 (13.89%)	6 (16.67%)
Very unimportant	0 (0.00%)	1 (2.78%)	1 (2.78%)
Unimportant	0 (0.00%)	2 (5.56%)	2 (5.56%)
Neither	6 (16.67%)	7 (19.44%)	5 (13.89%)
Important	10 (27.78%)	10 (27.78%)	7 (19.44%)
Very important	14 (38.89%)	11 (30.56%)	15 (41.67%)
Total	36 (100.00%)	36 (100.00%)	36 (100.00%)

Table 7.5 Importance of optional face-to-face support components

	Peer tutoring	Office hours
Did not use/attend	4 (11.43%)	6 (16.67%)
Very unimportant	1 (2.86%)	0 (0.00%)
Unimportant	0 (0.00%)	2 (5.56%)
Neither	9 (25.71%)	8 (22.22%)
Important	11 (31.43%)	11 (30.56%)
Very important	10 (28.57%)	9 (25.00%)
Total	35 (100.00%)	36 (100.00%)

Podcasts. The instructor shared that the topic of podcasts and ISs had come up during internal discussions within the biology department, as he had not previously been making a practice of providing podcasts of his lectures, at least partly out of a concern that an unintended consequence could be that students might take attendance less seriously, thinking they could simply listen later. As a result of the absence of podcasts, counselors had been in the habit of advising ISs not to take his course, but ISs seemed to be signing up anyway. Now that the podcasts were available, they seemed to be the most popular form of optional support among ISs (Tables 7.4 and 7.5), though the interviewees' experiences and perspectives on the podcasts differed in significant ways. Three out of four interviewees indicated that they did not use the podcasts, with Gladys expressing an interest in looking at other videos on YouTube and Yang indicating that he knew the lectures were recorded, but he felt the recordings were unnecessary in his case, as he was confident that it would be sufficient to look at the lecture PowerPoint while reviewing his notes (typically 3-4 pages handwritten in English per class). Maxine liked to use online videos in her studies and had fruitlessly searched for videos by the instructor on YouTube. She was thus convinced podcasts did not exist, but after learning about them in the course of her interview with me, she reported in her survey response that they were very important to her learning of the content.

Piazza. Another commonly used course component among the ISs was Piazza. As Yang explained, Piazza is an online "platform" that serves as a gathering place for students and the instructional staff to continue the classroom discussion experience online,

> because when you finish class, like, students are scattered around so we cannot discuss to each other and it provides a platform for us to post questions we don't know, and someone who understands the question could log in and give the answer, and then Dr. Sherman would, like, evaluate and see if the student's answer is correct or not. If it is not correct he would like, give some hints and then someone would maybe update a new reply or something. It's the same way but just a different platform for us to discuss with our classmates, because since it's online.

Yang said he never asked or answered questions there, but

> I read over the question someone asked and I think some are really good, and someone even post like he made a student-made review guide for all Bio 101 students to study, and he posted on it, and Dr. Sherman said it's really good, like he organized his notes really well and he shared it to us and it helped a lot in our quizzes.

Of the 36 ISs who completed the post-course survey, 29 checked Piazza about once a week or more, with only one person abstaining from its use altogether (Table 7.6).

Table 7.6 Responses to "How often did you check Piazza?"

Frequency	
Daily	6 (16.67%)
A Few Times A Week	14 (38.89%)
About Once a Week	9 (25.00%)
Less Than Once a Week	6 (16.67%)
Never	1 (2.78%)
Total	36 (100.00%)

Independent resources. TA Susan shared the impression that ISs who didn't attend office hours may prefer their own study groups, and student data supported this idea. In addition to one survey respondent who explained not attending office hours in precisely these

terms (“have a study group which is helpful”), Gladys also indicated a preference for help-seeking within her personal network, as described above.

WeChat. Harry provided a window on one common way that these Chinese students access the knowledge of their peers, via a messaging and social media app called WeChat (Figure 7.2). On WeChat, Chinese students attending the university created a group for fellow students like them. Once students join that group, they can find or be invited to other subgroups, like one for students of biology at the university, with 2,020 members, and they can set up groups for specific classes, such as the 33-member group for students in Professor Sherman’s Bio 101 course. Size of class seems to play a part in the likelihood of a WeChat group being formed, as Harry shared that he was also in a group for his math class, but he indicated that there was unlikely to be one for his Academic English class, which he said was very small. Presumably, if there were other Chinese students in the smaller class, he would have met them in class and perhaps chatted with them directly.

Harry referred to his biology class WeChat group as his study group, and he shared that members of the group use the app to send messages in Chinese to the whole group, as a way of discussing homework assignments and exchanging questions in advance of an exam. In this fashion, the app seemed to offer an alternative to the official Piazza site provided to the entire biology class and monitored by the instructional staff. This alternative might offer ISs a more comfortable place to discuss class content freely and benefit from one another’s insights, particularly if they shared Maxine’s concerns about looking foolish in front of domestic peers.

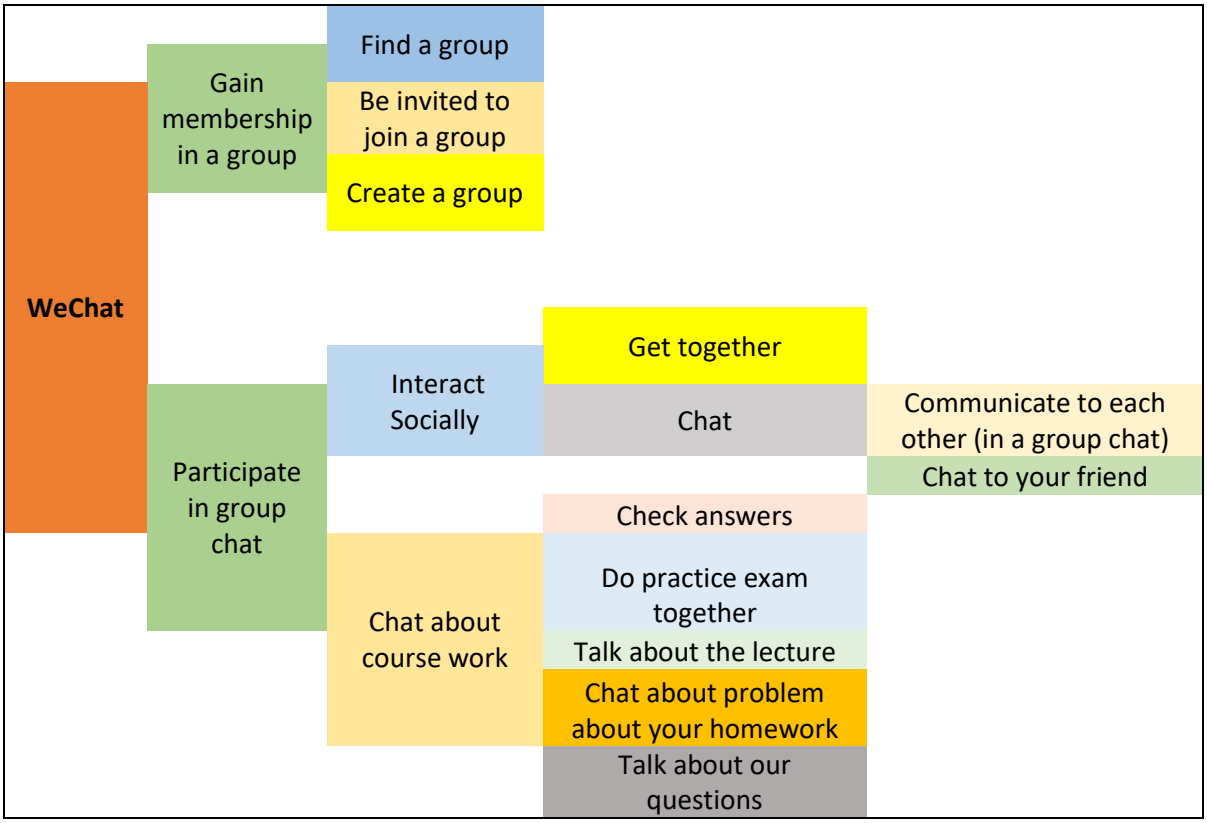


Figure 7.2. Taxonomic representation of the educational affordances of WeChat for Chinese students.

In addition to providing a safe space for Chinese students to help one another study, this parallel study environment serves as a means for the students to develop their self-reliance, which is something that the Chinese students seemed to feel was essential to their success as students. This emphasis on self-reliance was evident in various places in the data. For instance, it underscored the advice Gladys received from peers who had already been to America, which she said she would pass along to those coming after her:

> preparation for each class is very important and in America you need to study by yourself… you need to study much beyond class. …[China is] totally different… in China teachers can tell you everything and uh make you know how to get high grades how to and where to take practice and teachers will tell you everything. Our teachers will spend many times on your examination for

> you to prepare for it but in America you need to study by yourself beyond class, you need to spend more time to revise to prepare for class.

Four other ISs expressed similar sentiments on the post-course survey. In response to the open-ended "What is the most important thing that you learned in class this quarter?" three wrote: "How to read textbook and find answers by myself," "The way to study by myself," and "Self study and time management are important," and elsewhere in the survey Maxine expressed that "self learning" was the component of the course that helped her develop her English skills the most.

YouTube Videos. For Gladys, the theme of self-reliance in her studies surfaced in an unexpected fashion early in her interview, when she declared, "I want to talk about a class which gave me a deep impression. The class Sherman talked about mitosis." Gladys said she had had trouble understanding mitosis when she studied it in high school in China, but that she now understood it better. However, when I asked how the professor's class had helped her understand it, she said, "actually, after class I look at many videos about biology and it helps me learn a lot. In my country there's actually no videos on the internet but in America, yeah." She then shared that she had developed a study strategy of looking up videos for "many of classes." "It's in a YouTube," she added. "A good teacher send his videos on the internet and I can look at it." Not only did these videos provide an additional opportunity for her to achieve understanding, they allowed her to do so without the need to interact with the class's instructional staff, and they represented a unique benefit of studying in America, via an internet relatively free of government constraints.

Gladys was not alone in seeking out and using videos on the internet. A total of 15 ISs, including Gladys, responded on the survey that they used Khan Academy (n=7) and/or other online videos (n=13). Many ISs seemed to appreciate the *Mastering Biology* videos that were provided on the course website as well, as 25/36 students said they watched the videos "often" or "all the time" (Table 7.7).

Table 7.7 Frequency of watching videos that were in the *Mastering Biology* pre-class assignments

All of the time	15 (41.67%)
Often	10 (27.78%)
Sometimes	9 (25.00%)
Rarely	1 (2.78%)
Never	1 (2.78%)
Total	36 (100.00%)

In sum, it appears that many ISs felt it was important to develop their own self-reliance, and that the Chinese students had a healthy network of social and academic support that existed outside the resources provided by the course. Still, many ISs also made use of face-to-face and online resources provided within the course, with a possible preference for the online options. One question of interest is the extent to which the ISs' preferences and patterns of participation were influenced by challenges related to the fact that they were learning the content through ESL. I turn to this question in the next chapter, as I investigate the data to see how their participation and learning were impacted by their use of English as an L2, as well as how the course may have facilitated the development of their language skills.

Chapter Eight: Language Challenges and Opportunities for ISs

A highly structured introductory biology course taught through active learning offers a unique context for learners of English. Certain components, such as the engagement in active learning, the rigor of the high structure design, the focus on higher order thinking, and the mindfulness of metacognition may prove as beneficial to ISs as they would to anyone else. On the other hand, these components and others may pose special challenges when negotiated through a second language, especially aspects like the reading loads, vocabulary, peer interaction, and listening to informal discussion.

In this chapter I examine the course from the perspective of language. Drawing from survey data, interviews with ISs and with the instructional staff, and field notes, I investigate the unique challenges posed as students seek to learn biology content through a foreign language. Though the course was not designed with language learners in mind, and offers no explicit language instruction or support for ISs, I also explore the possibility that a highly structured active learning environment supported by a constellation of resources may offer language learning opportunities nonetheless.

When asked for their thoughts about the language demands and affordances of the course, ISs typically focused on vocabulary, speaking, and reading components of the course. I turn to each of these components in turn below.

Vocabulary

"You are learning a new language in this class. The language of biology is a new language." With that, six minutes into the second class, the instructor announced that

effectively all students in this course would be language learners. TA Hannah echoed this sentiment in her discussion sections: “I pointed out it’s kind of a new language for everyone, it’s biology. Even the native speakers are going ‘What?’ In a way it kind of levels the playing field.” Still, if the course made language learners out of everyone, it did not make the instructional staff into language teachers. In that second class, the instructor explained that although there were many terms the students needed to learn, they would *not* be explicitly taught in class, and on exams students would not get credit for simply memorizing – “on the exam you will never see a basic definition question.” Instead, students had to come to class ready to apply the terms to new situations.

ISs recognized the challenge. In response to the open-ended post-course survey question “What is the most difficult thing about studying biology in English?” 16 of the 25 ISs’ answers focused on concerns about vocabulary, making this the most commonly reported issue by far. “[T]oo many vocabularies,” they wrote, or “Too many words,” or simply “Words, words, words!!!” They were concerned about the sheer volume, and they were concerned about the challenges of memorization. ISs may have appreciated the supposed equal footing this placed them on with their non-IS peers, but they still felt their position was worse. Maxine reported,

> For biology you have a lot of academic terms and which is really academic, and you have to memorize it. Even for the local people it’s hard for them to memorize how to spell it, how to speak it right. So, mostly, even for local people it’s hard for them to say, “Oh I want to say this term but I can’t remember.” It’s harder for us to say that.

Survey respondents referred to cross-linguistic challenges, such as the difficulty of “memorizing specific names when knowing that I had memorized them before in Chinese,” and “Biology is a language itself that i managed to learn but one thing that scared me for the test

was what if there is a word that I do not understand and then I would not be able to answer the question even if I know the biology concept because it has happened before." Another student demonstrated that this concern was prevalent from the start, with a pre-course survey response saying, "I learned Biology in high school and I got a well grade. I hope I can learn it well in another language."

In addition to learning the biology vocabulary, many ISs still needed help with basic academic language, but they rarely turned to their TAs for help. TA Douglas reported that although he was asked the meaning of "stimulate" when he informally joined a group that was working on a problem related to cellular activity, ISs otherwise never asked vocabulary questions in class. On the rare occasion when ISs did make their language needs known, TAs were responsive. As Donna explained,

> The one thing I noticed was that I used some more complicated English vocab, and that's when one of the students came up to me and was like, "What does this word mean?" and then I realized. That came up like week two or something, so after that I would really watch myself, not use such complicated language at times.

Instead of turning to their TAs, the ISs seemed to make use of other resources to meet their academic and biology vocabulary needs, independently. I observed students looking up words on their phones during lecture, and Gladys shared that she too was in the habit of using a dictionary app. All told, at least twenty ISs used dictionaries in their L1, according to the survey responses, and other L1 resources included online videos (n=7) and old notebooks or textbooks (n=2).

In this fashion, students were naturally drawing on their first language as a resource. However, some had concerns about the impact of relying on their L1 too much. As Maxine recounted,

> some Chinese students who are also in biology major they try to memorize all the knowledge points in Chinese …because they took the biology class in Chinese when they were in high school and they know that "Oh, this term is something in Chinese" …But it's not good for test or the future study. …They post something like "Oh shoot. Why I memorize it in Chinese, I will fail it in the midterm because I don't know what the professor is talking about."

To address this dilemma, Yang shared that although he often turned to websites and videos in Chinese when he had to learn difficult biological processes, he then made a point to translate what he had learned into English. For her part, Maxine avoided using her L1 altogether. Instead, she would

> just try to memorize it in English and relate it to a graph or some priorities to this term, and I will just try to tap something which is similar …and I will check it and I will speak even right away.

Finally, some students found that preparation was the best strategy when it came to vocabulary. Gladys reported that she was in the habit of downloading the instructor's PowerPoint the day before class and referring to the slide with key terms, looking up the words she did not know.

Speaking

Concerns about Speaking

Yang also made a practice of preparing for class by looking up vocabulary he encountered in the book. In addition to wanting to learn the meaning, he was concerned about his ability to use the words in speech.

> I also would look up on internet to see how the word is pronounced, because if in case I want to answer questions I could pronounce that term, and it would not be so awkward. If you pronounce it wrong, like it's- also people pronounce it correctly. Because I think they are, they speak perfect English so… Like you could copy and paste the word and find pronunciation of a word. So, this would be helpful, I think so. Before going to class, yes, especially for Chinese students, yes.

Yang seemed to feel awkward speaking in class, apparently out of a concern that he would say the wrong thing and stand out in relation to his non-IS peers. Maxine similarly described a fear of being laughed at in her classes, as described in chapter six. Though Julia was not Maxine's or Yang's TA, she observed the same tendency among her ISs in discussion section:

> I think sometimes they're a little timid about like saying some of the science words. Just because, I mean, growing up with English you know there's so many roles[2], that, you know, sometimes you're going to say something and it's not going to be right, but everyone's like whatever. But I think with the language barrier, they're kind of a little more self-conscious about saying the word wrong.

Other TAs also described ISs as unlikely to ask questions in their classes and "hesitant to speak." This could imbue ISs with a certain invisibility – during TA Kirsty's interview she initially remembered only one of her three ISs, because the other two "never spoke," and TA Elena similarly had to reverse an initial claim that she had no ISs.

Yang explained Chinese and Taiwanese students' reluctance to speak as a matter of confidence, conservatism, and concerns about peers' perceptions:

> I think those students [who speak up in lecture] are confident. They are confident that they could answer those questions correctly and also they are not ashamed to show that they don't know something and what their weakness is, and this is a trait I see in non-Chinese students. I always think that because foreign teachers always encourage students to be active in class and

[2] Incidentally, when Julia used the word "role" instead of the seemingly more appropriate "rule," she may have inadvertently demonstrated her point that L1 speakers of English do not care as much about usage errors.

> have courage if they have things they don't know. They could just ask and, but, like Chinese students are too conservative sometimes, and I think this is what I should learn from them. Like even though, like, if you have questions but you don't ask, like it will make you feel like "Oh that's ok no one knows that I am stupid or something," but, but actually no one cares about that. You just need to care about whether your problem is solved or not. You don't need to care about your, how do you say, reputation or something. It is not really that important. The most important thing is getting your problem solved or something.

Engaging the Quiet Students

Some TAs were eager to get these quieter students to participate, and might take a seat near them and attempt to engage them during turn-and-talk portions of lecture, though the instructor stated that this was the TAs' decision and not personally his preference. In her discussion section Hannah took this tendency a step further, demanding participation and making concessions for no one. She stated that her students were fine with cold calling (i.e., calling on particular students to answer questions rather than taking volunteers) because she gives them candy, but she also shared a story about an exchange with a non-international student:

> There was one student that I didn't exactly cold call her. I just simply wanted her to come to the board and draw out a breakdown of a problem, and I was going to be talking with the entire class and we would be basically telling her what to write on the board. And she was trying to refuse, and I'm like "There's no refusing, I'm sorry." …Some people, some TAs find that aggressive, but that's just kind of my style. I don't take any - there's no, I don't mess around. Like, everyone's going to have a chance to come up and talk in my class. There's no hiding in the corner. This is a skill you need for life.

Hannah's firm stance may have been an outlier among the instructional staff. Although Amanda knew her students' names, she expressed a disinclination to cold call her students because of the anxiety it could induce, and my interviews with the other TAs as well as my observations of

discussion sections confirm that cold calling was rare. Some TAs found creative alternatives to inducing participation, however. Douglas refused to give an answer to a question until a student had made an attempt first, and at times this meant that students left class with some of their questions unanswered. Amanda would set up group tasks that required such individual roles as "reporter" and "drawer," and she would let the group members decide for themselves who should take what role.

Susan used a special way of calling on ISs to participate in class discussion, recognizing that sometimes they needed a moment to "bounce something off each other in another language, I think to just increase the, the comprehension and then get back to me in English." She found that when she returned to them, they often had the answer. Incidentally, Douglas, Hannah, and other TAs reported that this may have been a typical practice for the ISs, as at times they noticed ISs sitting together in discussion section and in lecture using their L1, and six IS survey respondents listed "talking to friends" as an L1 resource that they made use of. Susan's perspective was that

> …it is helpful at least in this class how there is so much pair and partner work or small group work. Dr. Sherman will often pose a question, have them discuss it with their neighbor and maybe ask them again. And I think that can help, especially for the international ones if there is something that they don't get with a term, or a concept, and it's just not clicking, then they have a chance to speak with a neighbor either in English or in another language and just clarify that. So, again a lot of these things apply to not ESL students but I see how it could be very helpful to the students.

Students had ample opportunity to 'bounce ideas off of one another' during the peer instruction segments of the lectures, and the IS interviewees all seemed to see great benefit to the practice overall, for it helped them understand both the questions and the answers. In

addition, Harry felt that when these conversations took place in English they helped him improve his language skills, and he thus described "chat with your neighbor" as the most interesting part of class, despite his report that "speaking [in English] is the hardest part for me." However, most interviewees also stated that they felt awkward about these conversations when they were not seated with friends, and that they were not comfortable being the first to speak.

Discussion Section Practices that Facilitated Participation

Discussion sections made use of various practices that had the potential to make students more comfortable with active participation and talking to peers. These practices included icebreakers, small group work, and collaborative quizzes.

Icebreakers. At the start, the instructor asked TAs to dedicate their first sessions to icebreakers, both to get to know one another and to get familiar with the style of the class. As Douglas described,

> The idea with that was to get them used to the idea of talking to each other and that they're going to have to talk and they're going to have to work with each other. They're not just filling out worksheets by themselves. So just sort of ice breaker with each other and with the structure of the class was sort of the idea.

A further outcome of the first class was that students would get a notecard that had the contact information of a classmate, "so they have someone they can ask questions with because a lot of times I think some student, again the ones who are less likely to participate, become isolated in the class." In her follow-up interview Maxine shared that these practices may have been effective, for on her first day of discussion section she made a non-IS friend who she continued to be in close contact with more than a year later.

Small group discussions. Small group discussions were a constant feature of these discussion sections. Whereas TA James let the students self-select into their own groups and therefore had two classes that had one group each that consisted solely of Chinese students, most TAs took a hands-on approach to mixing the students into new groups every week. TA Carla explained that interaction with different peers in English was essential: "You have to speak to learn the language. And biology, that's another language in addition." Yang seemed to agree:

> I like the mix group because… like you put a group of Chinese students here they will instead start using Chinese and they are not learning anything. Like the reason they came here is to learn more about the things they are interested in so make their English better and they are just, how you say, they are just wasting their time. They are not here just to be speak Chinese, yes… If you get the chance to talk to a foreign student you would force yourself to use English because you know that Chinese would not work on them. They would not understand. So you would, like try to speak in a way that they would understand. Also maybe they would, how do you say, give you correction on your English like, "Oh this part is wrong. I think instead you should use this when you say this sentence." I think they would sometimes, if you are willing to ask, I think they would help you. Also correct your speaking. I think so.

Mixing students into random groups often succeeded in breaking up the ISs, but the results were not always quite as ideal as Yang described. Two TAs reported that this could lead to the IS being left out, as "sometimes [the non-IS peers] ignore the international student and just kind of like do the work." Still, the TAs reported that they did not let this situation stand. Hannah's response was that she

> really emphasized, like "I will call on the person who is being quiet. Nobody is free of this, you know, you need to make sure they understand." And I would walk around and make sure that, that the student wasn't being quiet, that they were actually participating in the conversation. If they were being quiet I would try to initiate a conversation with them and involve the whole group to try and work on something together. So yeah, I think they really appreciate that.

When Amanda noticed that her one IS was being left out by his group mates, she decided to plan the group assignments the next week such that he would be in a group with other Asian students, in the hope that someone might also speak Chinese and might be sympathetic or bilingual. However, she reported that this solution did not work out, as the group did not work together very actively. They "just wanted to zoom on with their stuff," and they did not seem to want to interact. "They weren't turned toward each other," Amanda observed, and she could tell that his group "was not throwing him a bone at all. They weren't helping him." Still, I noted that later in the quarter this student did seem to have made friends with one of these students, or at least was comfortable enough to ask her questions at various times throughout the discussion section session.

Collaborative quizzes. Discussion sections routinely ended with a quiz, which the students completed independently first, then joined together to compare answers and fill out a fresh copy that would be counted as the grade for the group. Maxine reported that because the group quiz counted for her grade, she felt compelled to debate the answers with her peers, and she said this made for the best language practice she got from the course. It may have also played a part in her increasing comfort with speaking up in discussion section, as she reported that she came to feel that this was a place where she would not be laughed at. TA Julia's account further indicates the benefit of this form of group work, as it

> helped them to a certain extent just because then you get a chance to see what you know and talk with your group. And so, if you're having problems with the English, the other members of the group can try to help explain the question. Because as I was listening in that's a lot of the times what they were doing. It's like "No, the question is asking this."

After the quizzes were collected, the TAs would go over the answers with the class. Hannah and Julia noted that this was when they could really detect that their students were becoming comfortable with one another. Hannah reported,

> honestly my discussion sessions kind of become a community and they will joke and help each other and call each other out. It's like, "No, that's wrong!" And you know, they'll sigh together when they all get it wrong and cheer together when they all get it right, so. For the most part as the course goes along they become more willing to talk.

Julia's experience was quite similar:

> Then as you're going through the answers you know if you got it right, you know everybody is happy and if you got it wrong they're like "Aaaaa!" and you would hear their, like, the group sigh as a group. I think it helped with the sense of community of, like, the class in general.

Perhaps also in response to these classroom practices, TAs observed that even the shyest of students seemed to warm up over the course of the quarter. As Carla noted of one of her quieter students, "Toward the end of the quarter she got a little more confident and in the group she would be like 'Well, I got *this*' and then other people would be like 'Oh, me too.' She initiated it." These classroom practices may also explain why the second most common responses to the question of which aspect of the course helped them develop their English skills the most were along the lines of "discussion section" or "discuss with my neighbor" (10 out of 19 responses).

Reading

The most common responses to "Which aspect of the course helped you develop your English skills the most?" focused on reading and reading guides (11 out of 19 responses), and two ISs identified reading as the most difficult thing about studying biology in English, saying,

"Alot [*sic*] of reading to do which takes longer time for international students," and "understand the concept in the textbook much slower than local students."

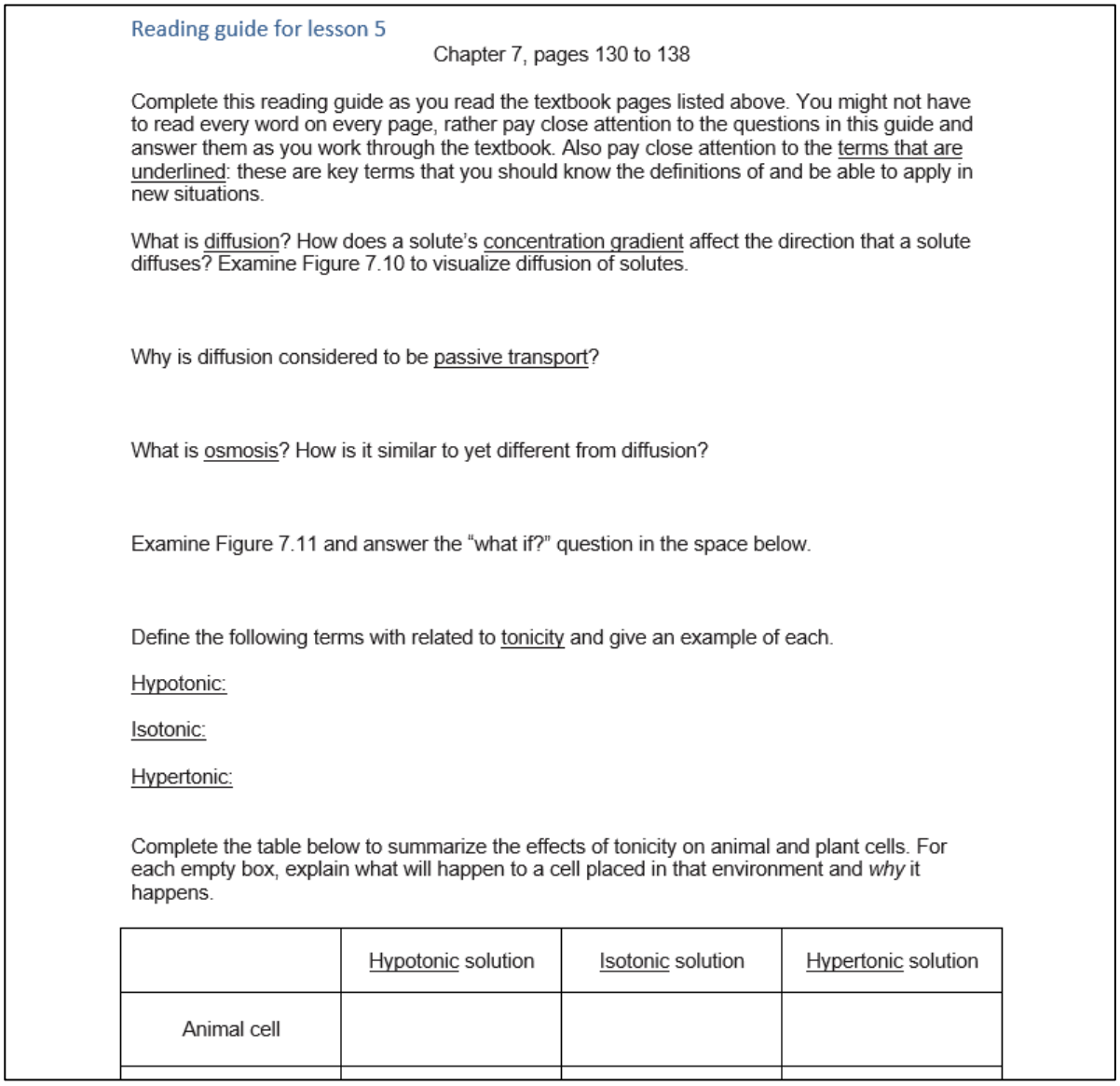
An excerpt from my interview with Gladys helps identify the problem, as the textbook was "too heavy":

> **Interviewer**: And do you read the textbook?
> **Gladys:** Sometimes. Because the textbook is too heavy.
> **Interviewer**: So you don't have the electronic textbook, you have the paper one?
> **Gladys:** Uh I have electronic textbook, but uh I want to get important point so the content is too much.

Reading Guides

For his part, the instructor was aware that the textbook content was "too much," and he therefore made reading guides to support the students and identify which parts of the chapters they should focus on, and which parts they could skip (Figure 8.1). He speculated that these reading guides might be the best aspect of the course for ISs in terms of providing language support. As described above, open-ended survey responses endorsed his hunch. In addition, 89% of ISs rated reading guides important/very important to their understanding of course content, and 58% ranked the combination of textbook and reading guide as the single "most useful part of the class in terms of learning the course material," by far the most common selection (over textbook alone at 8%, and over in-class lessons or *Mastering Biology*, at 17% each) (Table 6.6). These optional guides apparently played an important role in the "high structure" nature of the course, as they seemed to help students complete their mandatory pre-class assignments and thus prepare for class effectively. In response to "What best describes your use of reading guides?" 42% of the ISs selected, "I complete the reading guides

every day before doing the pre-class *Mastering Biology* assignments," and another 42% selected that they completed them beforehand "sometimes, but not all of the time." Only two IS survey respondents reported not using the guides at all.



Reading guide for lesson 5

Chapter 7, pages 130 to 138

Complete this reading guide as you read the textbook pages listed above. You might not have to read every word on every page, rather pay close attention to the questions in this guide and answer them as you work through the textbook. Also pay close attention to the terms that are underlined: these are key terms that you should know the definitions of and be able to apply in new situations.

What is diffusion? How does a solute's concentration gradient affect the direction that a solute diffuses? Examine Figure 7.10 to visualize diffusion of solutes.

Why is diffusion considered to be passive transport?

What is osmosis? How is it similar to yet different from diffusion?

Examine Figure 7.11 and answer the "what if?" question in the space below.

Define the following terms with related to tonicity and give an example of each.

Hypotonic:

Isotonic:

Hypertonic:

Complete the table below to summarize the effects of tonicity on animal and plant cells. For each empty box, explain what will happen to a cell placed in that environment and *why* it happens.

	Hypotonic solution	Isotonic solution	Hypertonic solution
Animal cell			

Figure 8.1. Reading guide for lesson five.

ISs also reported that they spent a fair amount of time on the reading guides, with 44% saying their total time completing them was more than 90 minutes (Table 8.1). This was in contrast to their non-IS peers, of whom 35% reported spending 90 minutes or more. If we

consider Maxine's insight that Chinese students are culturally inclined to downplay how much they study, it seems likely that the ISs may have spent even more time with these reading guides, reinforcing the other comments above that reading takes much longer for ISs.

Table 8.1 Responses to "How much total time did you typically spend completing the pre-class reading guides?"

	ISs	**Non-ISs**	**Whole class, 1st years**
0 to 30 minutes	2 (5.56%)	16 (8.47%)	63 (9.52%)
30 to 60 minutes	11 (30.56%)	44 (23.28%)	165 (24.92%)
60 to 90 minutes	7 (19.44%)	63 (33.33%)	203 (30.66%)
90 to 120 minutes	10 (27.78%)	29 (15.34%)	93 (14.05%)
Two to three hours	1 (2.78%)	23 (12.17%)	84 (12.69%)
Three+ hours	5 (13.89%)	14 (7.41%)	54 (8.16%)
Total	36	189	662

Note: "Whole class, 1st years" consists of all 1st year students who are not ISs and who are not missing data

Exam Prompts

Reading difficulties could also impact students' exam grades, for TA Julia found that one of her ISs needed her help in understanding paragraph-length question prompts on the practice exams.

> Usually you get like a paragraph and it tells all the info that you're supposed to figure out to solve the question. So I think sometimes they have problems like, just because it's like a block of English, with the science mixed in, and even if you understand the science terms, sometimes the English terms could be confusing. … If you can't get through all of the English of the question it's sometimes hard to understand the biology that they're asking about.

Julia reported that the same thing happened with her discussion section worksheets, that "it was usually the international students who were like 'I don't understand it' and so I'd have to go through it a little bit more." This circumstance highlights one of the potential benefits of the discussion sections for ISs. Because of the small size of the section, it was easier for TAs to get to know the students and tailor materials to suit their needs. In this case, Julia reported that

she learned from her interactions with the ISs and "got better as the course went on with explaining and having enough information in the introductory paragraph [of her worksheets] to explain it," it "was something I could change and make it easier for them."

Other Aspects of Language in Introductory Biology

The two core language skills as yet unmentioned are writing and listening. Although IS interviewees expressed that listening to the instructor-student discussion segments of the lecture sessions could be quite challenging, two survey respondents reported that listening to the professor helped them improve their listening skills. Comprehension of these lectures was likely aided by the instructor's provision of the PowerPoint a day in advance, which IS interviewees reported accessing as part of their preparation for class. The instructor's reliance on visuals in his slides was likely helpful as well. Finally, given the language-related challenges that much of the course might pose, it is perhaps unsurprising that the ISs especially seemed to appreciate the in-class videos that were occasionally incorporated into the lectures (rated 4.31 on a scale of one to five of importance to learning). These short clips ordinarily transcended language, bringing complex processes to life through visuals, rarely making any linguistic demands other than comprehension of the instructor's bookending remarks.

As for the topic of writing, it rarely came up in the data. This is unsurprising given that the primary form of assessment was multiple choice exams, and there were no papers or lab reports assigned, though students did have some extra credit writing projects as part of institutional research. In interviews ISs occasionally referred to writing demands in their other classes, and one did mention that writing would be a concern later on in the biology major, but for now it was not a concern.

In conclusion, it appears that ISs and instructional staff recognized both challenges and opportunities with regard to the learning of content and language. Though all students had reason to be concerned about the demands of learning copious amounts of new vocabulary, some ISs expressed the added concern that their prior learning of the biology content in their L1 might interfere with their performance through English, and other ISs expressed added discomfort with the possibility that they would use incorrect pronunciation. With regard to speaking, ISs may have tended to be shy, but the cooperative structure of discussion sections and the support of TAs may have helped ISs warm up to learning through peer interaction. Finally, reading posed added challenges, but the instructor's provision of reading guides to all students was a practice that may have been especially well-suited to ISs.

Chapter Nine: Discussion and Conclusion

Content learning in higher education through English as a foreign language poses many challenges for ISs. Many are underprepared for the discipline-specific readings (Smith, 2004), the heavy demands on their listening and speaking skills (Ferris, 2009; Leki, 1992; Reid, 1997; Wright, 2010), and more. Such challenges can diminish these students' participation in class (Airey, 2009), as well as their note-taking and comprehension (Airey & Linder, 2006), particularly if they are not able to handle high cognitive processing loads (Marsh & Laitinen, 2005), or if they are lacking in concentration or attention span (Klaassen & de Graaff, 2001). The combination of these challenges can lead to loss of confidence (Smith, 2004), learning difficulties (Yeh, 2014), and learning anxiety (Huang, 2015), with the cumulative result that students who were previously accustomed to academic success in their home countries may suddenly find themselves demoralized (Ryan, 2007).

Despite these multiple challenges, the ISs in this study received grades that were as good as or better than those of their non-IS peers, thus challenging notions that these students lack sufficient academic skills and are somehow a problem. In fact, one thing that makes the absence of a gap between these populations notable is the fact that the course was not designed with any particular focus on supporting L2 English users, though it employed active learning and high structure course design with the aim of facilitating the success of all learners. Whereas course features such as the provision of reading guides and ample out-of-class support may have been naturally suited to ISs' needs, the heavy reliance on discussion and peer interaction may have posed additional language challenges that these learners would not have

encountered in more traditional contexts. Nonetheless, at first glance it appears that these active learning techniques did not hurt the ISs, and they may have helped.

Complicating the picture for these ISs, however, is the fact that an examination of their grades in relation to their SAT math scores suggests that they may have been underperforming in relation to their academic potential (i.e., given the typical relationship between SAT math scores and grades for all students in the class, ISs' grades would be expected to be higher). Further analysis of TOEFL/SAT verbal test scores in relation to their course grades suggests that language issues were likely responsible for this discrepancy, for there was a strong relationship between the two. Examination of ISs' classroom behaviors and self-reports of their habits and perspectives provides further perspective on how the ISs engaged with active learning and what impact it had on their performance in the class, indicating that ISs were heterogeneous in their ways of participating and responding to active learning, that ISs felt that active learning posed both constraints and affordances with regard to their learning of course content, that ISs saw language-related issues as a threat to their content learning in this context, and that active learning and efforts at building community may have helped ISs navigate these language-related obstacles. In addition, the environment of a large lecture class with multiple points of entry to content learning may have posed unique opportunities for these students. I turn to each of these topics in greater detail below.

As we turn to this discussion, it is important to bear in mind some limitations of this study that set parameters on just what conclusions can be drawn. For instance, to confidently make statements about the broader population of ISs in higher education, I would need to have worked with a much larger sample of international and English-dominant students from many

different classes, and to make causal inferences would have required an experimental design. In addition, the statistical measures of academic ability (SAT math scores) and language ability (TOEFL scores) used here were imperfect, for neither one is designed to measure the specific academic or language skills required for biology content learning. Additional measures would have been useful to identify or rule out other variables that could impact students' performance in the course, such as motivation or prior study of biology. Finally, a concern regarding the post-course survey data is that its length (95 items) may have induced survey fatigue. As described in chapter four, I addressed some of these concerns by taking an approach of researcher as *bricoleur* (Denzin & Lincoln, 1994), collecting data from as many sources as possible in order to have the chance to triangulate findings and get a full picture of what was taking place in this classroom-based study.

ISs and Active Learning

Heterogeneity of ISs

Even within the Chinese-speaking sub-population of the class as represented by the four interviewees, ISs were distinct. Maxine and Yang seemed best versed in the pedagogical rationale behind various aspects of the course and were also well acquainted with recommended study practices, whereas Harry and Gladys provided relatively little evidence of this kind of awareness. Nonetheless, Yang did not ultimately do as well in the course as Harry did, and the four students' grades spanned from the top of the class (Maxine) to somewhere near the bottom (Gladys). Maxine described intense study habits that caused loss of sleep and visits to the instructor and numerous TAs, whereas Harry never went to office hours and did not take notes during class. Maxine, Harry, and Yang each saw benefit in peer instruction and small

group work, but they also shared that they felt awkward about it. On the other hand, Gladys expressed few reservations, apparently embracing the social aspect of the class. Whereas Maxine and Gladys were having their first experiences learning content through English, that was not the case for Yang and Harry, who had had parallel experiences in their high schools in Taiwan and China, respectively. With regard to the use of independent resources, Yang explained that WeChat is an app used by mainland Chinese, and that he thus was not a member of that online community. Survey responses from the 36 ISs also manifested this heterogeneity, as there were typically a small number of students whose answers bucked the general trends.

In short, each of these students differed in a range of ways, and their performance in the class was not always what might be expected. Therefore, any effort to address the needs of ISs must be undertaken with recognition of the likelihood that even within this subpopulation, one size will not fit all. However, it is also worth remembering that course modifications that provide essential support to students in need often amount to practices that are good for all (Zamel, 2004), or at the least they are likely to cause no harm (Caldwell, 2007).

Potential Benefits and Drawbacks of Active Learning and High Structure for ISs

Although regressing a composite of survey responses related to active learning on final biology scores did not yield a statistically significant relationship, ISs and TAs were able to identify several aspects of this high structure course taught through active learning that seemed to have a positive impact on ISs' content and language learning. These positive impacts were not uniform, however, and study participants also recognized certain drawbacks as well.

Small group work and collaborative quizzes. Studies show that small group work offers benefits over traditional lectures in terms of increases in academic achievement, positive

regard for learning, and persistence in the STEM disciplines, and it can allow students to experience the same kinds of interactions that scientists engage in (Springer et al., 1999). Though findings of this nature are for the most part beyond the scope of this study, ISs expressed generally favorable views of their small group work, as demonstrated in Yang's comments about the benefits he got from working with peers and also in the fact that 86% of ISs expressed that they would choose working in groups over working alone during discussion sections.

Still, studies have found that ISs may be underprepared for social interaction in their new culture (Yan & Berliner, 2016), and that domestic peers may fail to see the benefit of interacting with them (Jones & Kim, 2013). Related trends were reflected in observations shared by TAs in their interviews. In these TAs' views, ISs were reticent during group work and class discussion, and they noted that ISs were sometimes left behind by group members who went ahead and completed assignments without them. Though ISs seemed to warm up to their small group work and participate more actively as the quarter progressed, their initial (and, for some, lasting) reticence could give their TAs a negative impression of them, as was demonstrated in Carla's tendency to describe quiet ISs as students who "would just kinda sit back and let the other students do the work." Their reserve could even result in invisibility, as two TA interviewees initially overlooked the ISs in their midst, underreporting the number they had.

The most structured form of small group work was the collaborative quiz that students completed in their groups at the end of each discussion section. Studies indicate that such quizzes lead to improved scores (Eaton, 2009; Rao et al., 2002), as well as increased retention

of content learning over time (Cortright et al., 2003). Insofar as they use principles of cooperative learning, they also hold the potential to bring further benefits in students' higher-level reasoning, and their persistence in the course, as they facilitate the development of students' social networks (Smith et al., 2005). Furthermore, small group discussion of the quiz questions could afford opportunities for students to discuss class content together and "ensure that misconceptions, incorrect understanding, and gaps in understanding are identified and corrected, and that learning experiences are personalized" (Smith et al., 2005, p. 93), which could thus lead to learning gains as students "articulate their logic and consider other points of view when solving problems" (Haak et al., 2011).

Many of the above-mentioned benefits of collaborative quizzes seemed to apply to the ISs in this course. During collaborative quiz group work, TAs shared that they observed students helping one another understand the questions and how to answer them, and Maxine added that these quizzes were the best component of the course for developing her language skills, because the fact that they were graded made her feel compelled to debate the answers with her peers. TAs also noted that these quizzes seemed to foster a sense of community, as groups became invested in their answers and the quiz outcomes, and would respond vocally when the TA went over the answers at the end. Perhaps as a result of these experiences, IS interviewees reported that they had expanded their social networks by making friends in their discussion sections.

Peer instruction. Caldwell (2007) found that "students like clickers" (p. 13). The ISs in this study were no exception, with survey responses indicating that the general use of clickers was among the most popular of the active learning activities. Use of clickers for peer instruction

was also popular with IS survey respondents and interviewees, with its routine consisting of clicking in answers, discussing with neighbors, and clicking in again on the same question. Smith et al. (2009) report that the percentage of correct answers typically increases after this peer discussion, and the same was true for the use of peer instruction in Biology 101. Smith et al. (2009) elaborate that the positive benefits of this peer instruction seem to extend beyond groups where one student simply tells another the correct answer, as even "naïve" groups in which neither member originally had the right answer tend to shift toward the correct choice when they revote. Similar benefits may have held for the ISs in this study, as some ISs described dynamics in which the less knowledgeable students changed their answer to match their partners, whereas other ISs described discussions that resulted in better understanding of the questions and the content, without necessarily always changing their answer to match their peers.

Even though ISs generally placed great importance on peer instruction during lecture, three out of four IS interviewees explained that these interactions could be awkward. They detailed their discomfort initiating discussion, and Maxine shared that even when she spoke second she did not like to say much more than what her answer was. However, Maxine identified an important exception: When she was sitting with her friends, she would speak a lot. This observation holds implications for the importance of building community as a way of supporting active learning, and it may also point to the value of allowing students to use their L1. Each of these topics will be examined in further detail below.

High structure. Highly structured active learning course designs that develop and reinforce content and skill learning incrementally over the course of a term have been shown to

result in improved student performance, including for those students most at risk of failing (Freeman et al., 2007; Haak et al., 2011). Similarly, literature on L2 users of English in higher education indicates that transparency and explicit setting of expectations should be beneficial to ISs (Koch et al., 1997; Snow, 1997; Srole, 1997; Stillwell, 2017). In accordance with these prior findings, IS survey responses in this study indicate that the high structure course design of Biology 101 was useful to them as well. A large percentage of ISs (89%) reported that they found the pre-class assignments important to their learning of the content, and 42% were in the practice of preparing for those assignments, and thus preparing for class, by completing the reading guides in advance as well. In Harry's estimation, these high structure course features prepared him so well that he did not need to take notes in class, and his final grade of a B suggests that this self-assessment may have been accurate. In addition, most ISs (89%) expressed that the weekly quizzes, which divided the course content into smaller segments prior to the two midterms and final, were important to their learning. This connection to the largest assessments may have been especially valued by ISs like the three survey respondents who seemed to view the value of other aspects of the course, such as peer tutoring, in terms of how they would help them do well on the test.

Lecture discussions. Discussion may be the most common form of active learning (Bonwell & Eison, 1991), an essential means of prompting the kinds of thinking necessary for the understanding of course content (Brame, 2016). Yet for ISs this common practice may pose special challenges given the heavy demands made on listening and speaking skills (Ferris, 2009; Leki, 1992; Reid, 1997; Wright, 2010). In my field notes I observed that few ISs actively participated in these class-wide discussions other than a single Persian student, and in their

interviews two ISs expressed reluctance to participate out of a fear of saying the wrong thing. As Yang elaborated, asking questions in the class would require a level of confidence not typical of Chinese students, who might be concerned that they would look stupid for not knowing something.

Even the seemingly basic task of listening to these question and answer segments was no simple matter, for these segments were of such a nature that they might challenge the concentration and comprehension of even the most dedicated and capable student, as they were unsupported by visuals and they were punctuated by inaudible gaps when students made contributions that were not amplified into a microphone. Perhaps not coincidentally, I noticed some ISs who seemed to routinely use these times for pursuits other than simply listening and taking notes, such as revisiting other notes, the e-textbook, and/or the reading guide, or even taking the opportunity for texting. Though 86% of ISs' self-report survey responses indicated that they typically paid close attention during these occasions, 44% verified my observations as they admitted to also using this time for additional activities. Furthermore, two interviewees commented that they found these parts of class hard to follow, and on the occasion of the last class when the instructor permitted students to leave before the final discussion and many non-IS students did so, eight of the ten ISs I was tracking left as well. It seems this was an area of the course that could use modification in order to support students' engagement.

"It's not for everyone." Of his own prior experience with active learning, the instructor shared

> I remember I hated group work. I hated doing activities in class, out of class, …It was like, "I don't want to work with anyone." So I know it's not for everyone. So I do find it funny that now all I do is I push that so much. When I

> was, I would hate it, if I had a class like mine that made you do all this talking. I would have been one of the students in the back that didn't talk. …[So] I'm not going to force everyone to do it. Because I know not everyone wants to. I, in a way, I'm fortunate that I don't teach really small classes, like less than 30 because if I did on a regular basis all I would do is make the students work together and not everyone's going to want to do that. But in the larger classes of at least 140 students they can hide in the back, and that's ok.

Although the instructor conveyed this sentiment to the TAs, not all were on board. Some would make a point of engaging the quieter students during peer instruction segments of lecture, and Hannah detailed a firm stance on making everyone speak in front of her discussion section at one point or another. It seems likely that moments like those would be extremely uncomfortable for ISs like Maxine and Yang, students who expressed great concern about looking foolish in front of their peers.

Language Challenges and Opportunities

In survey responses and in interviews, ISs identified language-related challenges and opportunities presented by the course. Chief among these were components of the course that engaged the students' speaking, vocabulary, and reading skills.

Speaking. The course's frequent use of peer interaction seems to have made speaking a prevalent language feature in the minds of the ISs, as seven of the nineteen survey respondents to "What aspects of this course helped you develop your English skills the most?" selected variations on 'talking to my neighbor,' though only one noted this aspect of the course in response to the question "What is the most difficult thing about studying biology in English?" Despite the relative absence of mention of speaking as a challenge in these survey responses, three of the four IS interviewees expressed that they felt awkwardness and reticence when it

came to engaging in active learning with peers, and TA interviewees similarly noted a tendency toward silence among their ISs in discussion sections.

Yang was an interesting example in this regard, as he was an interviewee that I occasionally observed keeping to himself during lectures, but who in his interview expressed appreciation for the value of such interaction. In his estimation, ISs come to university in the U.S. out of an interest in developing their English skills. Mixing ISs into different small groups helps, he said, by making sure that they are not just "wasting their time" using their native language. In these mixed groups, ISs have to speak in a way that their non-IS peers would understand, and these peers "give you correction on your English like 'Oh this part is wrong. I think instead you should use this when you say this sentence.' I think they would help you."

It is worth noting that Yang's response indicates a positive response to being obliged to talk, as he was referring to instances when the TAs assigned the students partners. Maxine saw similar value in such mandated participation, as in the collaborative quiz portion of the small group work, which compelled her to negotiate the responses to questions with her peers in an effort to get a good (shared) grade. These cases suggest an endorsement of TA Donna's perspective that structuring students' participation through such means as assigning them to groups makes for more comfortable peer interactions than asking students to find partners, as the expectations set by an authority figure remove the potential social awkwardness of ISs having to work out ways of participating for themselves.

Vocabulary. Many ISs (16 of 21 who answered the question about what was difficult about studying biology in English) were anxious about the sheer number of words to learn and the challenge of memorizing them, and in their open-ended survey responses some expressed

the added concern that their understanding of biology content in their L1 would not be reflected in their L2 assessments, or that their failure to understand the wording of a test question would preclude them from answering correctly even when they understood the underlying concepts. To address these challenges, two interviewees shared strategies for dealing with this vocabulary: They looked at key terms in the readings or the instructor's PowerPoint before class, learning the meanings so as to better understand the lesson. One TA also offered support, modifying her worksheets to reduce vocabulary challenges in the prompts. However, these vocabulary challenges may have been a persistent concern, as there was no mention of such adjustments taking place for the exams, and only two ISs listed vocabulary as an area where their English skills had improved over the course of the term.

Reading. Apart from students' concerns about being able to read and understand test prompts, several ISs expressed that the readings were heavy, and that having to do readings through English as their L2 meant that they would "understand the concept in the textbook much slower than local students." In a follow-up interview for member checking, Yang reported that when it came time to study, he was simply too overwhelmed by the density of the textbook to read as much as he knew he should, and he therefore felt that his final grade falling short of an A was appropriate – he knew he had not overcome his reluctance and put in the work necessary. Despite or perhaps because of the heavy challenge posed by the readings, reading was one of the areas where ISs saw the most growth, as nine of the nineteen survey respondents chose reading as an aspect of their language that had been developed by the course.

Community and Comfort

Active learning requires a great deal of peer interaction, which may have been an alien experience for ISs who were more accustomed to traditional lectures and teacher-centered instruction. Though IS survey responses indicated that they ranked peer instruction as an important part of their learning (rated 4.14/5 on a scale of importance from very unimportant to very important), three of the four IS interviewees expressed that discomfort with speaking in front of peers impacted their experience. One important factor may have been the extent to which they felt comfortable with their peers, as members of a shared community, or not. For instance, Maxine reported that her participation in peer instruction was affected by her familiarity with her classmates such that when she was sitting with friends, she would speak a lot, but otherwise she would wait for the other person to speak first, and would say little more than the minimum in response. Yang and Harry also expressed feeling awkward in such conversations, and Yang added that students who spoke up during lecture would have to have a high level of confidence. Maxine stated that she would never answer or ask questions during the large lectures for fear of being laughed at, but in her smaller discussion section she felt more comfortable speaking up. In these cases, a lack of comfort and community may have been associated with a minimum of output from ISs, which could thus impoverish the learning environment for them and for their peers.

The instructor seemed to recognize the importance of creating an environment in which students would be comfortable interacting with one another. For instance, in an interview he told me that he felt that students in a large lecture might feel anonymous, but that his learning of their names could help foster a sense of community. Thus, he routinely asked for and used contributors' names during lecture discussions. A Persian IS who participated in these

discussions reported that she appreciated this, and the instructor shared that his use of names was something that students tended to highlight when they wrote their evaluations of the course at the end of each quarter. To extend this community-building to the discussion sections, the instructor encouraged the TAs to learn the names of their students as well. Some TAs reported that learning ~90 names was not something they felt capable of, but TA Donna managed to do so, and she reported a possible impact on an IS, a seemingly shy student who later surprised her with a vocal greeting when she chanced upon her in public.

Other practices that were potentially facilitative of community were built into the structure of the discussion sections. These sessions typically began with icebreaker activities on day one, and from the second week onward they were characterized by routine use of small group work. Within this context, TAs Hannah and Julia shared that a sense of community seemed to develop naturally. For instance, as the students filled out their single copy of the collaborative quiz, the TAs observed them helping one another understand the questions, and when the TAs revealed the correct answers afterwards, the students demonstrated their group unity as they uniformly reacted with joy or grief.

Finally, Maxine provided further evidence that these efforts at community building had a positive impact, as she reported that she made a lasting friendship with a non-IS classmate on the first day of her discussion section, and the other IS interviewees similarly reported making friends in these sections. They were apparently not alone, as survey responses showed that 94% of ISs had made at least one friend or acquaintance from the course, and 58% had made three or more. In an anonymizing sea of over 400 students per lecture class, this is perhaps no small accomplishment.

Opportunities to Use the L1

One benefit of the large lecture context is that when the whole room was discussing a question with their neighbors, it was too noisy for anyone to notice if some students chose to speak a language other than English. Thus, it would seem that ISs need not be concerned about alienating non-IS peers by using their L1. During my lecture observations, I noted that many ISs tended to sit with the same IS peers every day, and at times I did detect the use of languages other than English.

Maxine was one such student, who I observed sitting beside Gladys on more than one occasion. In those instances, the two students had recourse to first language resources as necessary, which could presumably facilitate deeper comprehension and quicker resolution of misunderstandings. In addition, I would speculate that they might have felt more confident using English, as they could feel less fear of being laughed at for saying the wrong thing. However, in their interviews Maxine and Yang reported great concern about relying on their L1 very much, for fear that they would not learn the content in English sufficiently to express their understanding on the exams. In addition, in a follow-up member checking interview Maxine said that sitting with a peer who shared the same L1 was not good for her participation in peer interaction, as she felt compelled to speak English among the surrounding local students and TAs, yet she felt foolish doing so in communication with a peer who shared her L1. As a result, their exchanges tended to be superficial.

Strategies and Self-Direction

The course was also notable for the high number of points of entry to content learning that it offered to the students, in terms of such resources as peer tutoring, instructor and TA

office hours, the online bulletin board, podcasts of the lectures, reading guides and more. Students thus had a wealth of opportunities to support and enhance their learning as they saw fit. Though this may seem to be an ideal circumstance, Yan and Berliner (2016) note that Chinese students in particular may face difficulty adjusting to the self-directedness of U.S. schooling, being previously accustomed to having mentors and instructors tell them what to do. Gladys echoed this observation when she shared the advice she had been given about studying in the U.S.:

> …preparation for each class is very important and in America you need to study by yourself… you need to study much beyond class. You need to learn. [That's totally different than China.] …In China teachers can tell you everything and uh make you know how to get high grades, how to and where to take practice and teachers will tell you everything. Our teachers will spend many times on your examination for you to prepare for it but in America you need to study by yourself beyond class, you need to spend more time to revise to prepare for class.

Given the great academic potential suggested by their high SAT math scores, it is not surprising that these students ultimately had what it took to succeed. Several IS survey respondents said that the most important lesson they had learned in class during the term was not specifically related to the biology content, but was rather related to how to "find answers by myself" and "study by myself," and IS interviewees demonstrated the necessary self-reliance through the use of various strategies, from the elaborate measures Maxine took to prepare herself adequately for the exam, to Gladys' and Yang's habits of checking the meanings of key terms before coming to class. Various survey responses suggest that this capacity for strategic study and self-direction was not a completely new trait for all of them, as 14% of ISs reported that they would prefer to complete the discussion section worksheets independently, and

trends on other questions pointed toward a possible preference for online course components over face-to-face offerings, a tendency that has been noted elsewhere (Zhao et al., 2005), which also suggests a capacity for self-direction. Further evidence of their capacity to find answers outside of class comes from the mainland Chinese students' strategy of seeking help from within an independent community they had formed via WeChat.

Implications: Helping ISs with Active Learning and Language Concerns

On the whole ISs performed about as well in the class as their domestic peers, and possible reasons for this are suggested by certain trends found in the survey, interview, and field note data as described above. Naturally, the extent to which such findings can be extended to the population of ISs at large will be quite limited, but if indeed the findings of this study did pertain to ISs in other contexts, certain teaching practices would likely prove useful. In the following sections I highlight some such practices worthy of further investigation.

Facilitating Participation in the Classroom Community

Instead of hands-on, micro-level approaches to compelling students to participate in small group discussions such as those attempted by TAs who described creating a Chinese-only group or threatening to call on the quietest group member, broader efforts to build community may help ISs become comfortable participating in discussions large and small, voluntarily. Indeed, it may not be coincidental that the discussion sections, which began with icebreakers and the exchange of personal information among students, and which went on to make heavy use of cooperative learning, resulted in an environment in which students seemed to become more comfortable with discussion as the quarter progressed. Further embrace of cooperative learning principles endorsed by countless studies may lead to additional advances in this area,

such as having students work together toward common goals "under conditions that involve both *positive interdependence* (all members must cooperate to complete the task) and *individual and group accountability* (each member individually as well as all members collectively accountable for the work of the group)" (Smith, et al., 2005, p. 88).

Other practices used by TAs in this study may also play a part in building community and enhancing students' comfort with participation, such as giving students time to think and perhaps confer with neighbors before giving a response publicly, as TA Susan described, and as supported by research on think-pair-share (Kothiyal, Murthy, & Iyer, 2014). The instructor and TAs found that knowing students' names could have a positive influence as well, a practice Dörnyei and Murphey (2005) describe as facilitative of positive group dynamics. They add that classrooms might become even more cohesive when students learn one another's names and get to know one another. Naturally, these efforts can be aided by a practice that was reflected on favorably by TAs and ISs alike: having students mix into different groups, frequently.

Instructors also may be able to help develop a sense of community by leveraging their capacity to impact students' sense of belonging (Glass, Wongtrirat, & Buus, 2015). In the case of Biology 101 here described, one simple option may have been to modify the instructor's practice of beginning each lecture with casual comments about a particular television program, sports team, or the news. Although this practice was said by interviewees to play a role in increasing his approachability, one TA and some students said that their lack of interest in baseball meant that the comments actually did not mean much to them. Rather than focusing such comments on relatively narrow interests that will connect with only some, instructors might consider taking these casual moments to focus on interests relevant to all members of

the classroom community, such as topics related to the daily lives of the students or to new developments in the program, on the campus, and beyond. Further efforts to help students feel like they belong might involve instructors highlighting their own struggles with learning the content (and perhaps struggling with pronunciation of complex terms), showing that they too are human and that despite the challenges, success is possible. Instructors, TAs, and peer tutors from other countries who have learned the content through English as an additional language can similarly serve as role models to ISs in a powerful fashion.

Finally, it might be important to recognize, as the instructor stated, that active learning is not for everyone. Creating space for those who prefer other means of participation may lead to a more welcoming environment for all. Though the instructor clearly endorsed peer instruction during his lectures, and shared research on the benefits of active learning, he made a point not to trouble students who opted not to talk to a neighbor. Implementation of such a policy can even extend to discussion sections focused on group work, as in the case of one TA who honored a Brazilian IS's request to refrain from group work, allowing her to complete assignments and the collaborative quiz independently instead.

Listening to Discussions

To help ISs and all students keep up with open discussions that can be hard to hear and follow, it may be useful if a TA could take notes simultaneously into a projected PowerPoint slide, offering running subtitles. Given that I frequently observed ISs annotating their PowerPoint slides whenever something on the instructor's projected version filled in a gap, it seems likely that they would notice such support and find it useful. The benefit of such notes

might be extended if they are shared after class, perhaps on the class bulletin board or as captions on the podcast, to ensure that the fruits of the discussion can be fully accessed by all.

High Structure

ISs benefit from explicit expectations and the breaking of large tasks into smaller chunks (Koch et al., 1997). In Biology 101, pre-class assignments and weekly quizzes played a valued part in this, as did the provision of reading guides that identified the important parts of the textbook for students to focus on. Further support of this nature might also be appreciated, such as vocabulary learning support through online flashcards or something of the sort, ideally with an audio component that provides students with the correct pronunciations.

Reading

Reading guides played a role in helping students deal with intense reading demands, demands that were made all the more taxing given that ISs reported that understanding textbook content took them longer than it would for "local students." However, the textbook was not the ISs' only concern in relation to reading. Their SAT scores point at a related concern, which is that they tended to do better on math tests that are not language-based, whereas their verbal scores were a fair bit lower. On the biology exams, blocks of text that preceded questions on quizzes and exams posed concerns, as misunderstandings would lead to incorrect responses. To help address this concern, it can be useful for students to get practice with parallel questions during class, which is another aspect of a highly structured course design exhibited in the biology class here described. In addition, instructors might consider supplementing these questions with visuals, using other aspects of universal design for learning (Rose & Meyer, 2002), and having their questions vetted by colleagues who teach ESL. And in a

class taught with multilingual instructional staff, ISs might even be invited to use their L1 to elaborate on their responses to questions when necessary (Rea-Dickens, 2014; Robinson, 2010; Shohamy, 2012)

Use of L1

In the Biology 101 sessions, students sat with whomever they wanted, wherever they could find a seat. As Maxine stated, this autonomy was important to her engagement in active learning, for when she could sit with her friends, she would "talk a lot." Notably, when ISs have the freedom to sit with peers with similar linguistic backgrounds, and when the instructor makes frequent use of paired discussion, these partners have access to a powerful resource that may otherwise be hard to tap into: their L1. As I observed during lectures, when ISs spoke to one another during the peer interaction portions, some used English, some used their L1, and some used a mix. TAs also reported hearing ISs use their L1 when they were together in lecture or discussion section, and Susan shared that letting them talk to each other for a moment in the language of their choice before answering a question seemed to improve their participation.

Given that ISs' grades were associated with their language ability as reflected in their TOEFL scores, it appears that allowing students access to their L1 may be essential to their success. Such inclusion of students' first languages as resources for learning is a practice long advocated in TESOL (e.g., Chromá, 2006; García & Sylvan, 2011; Hornberger & Vaish, 2009; Levine, 2011; van der Walt & Kidd, 2012), as "The monolingual mindset that has traditionally been preeminent needs to be replaced by a multilingual mindset" (Doiz et al., 2012, p. 218). Survey responses provide further indication of the extent to which the L1 proved useful to

these students, as 33 out of the 36 ISs reported using L1 resources, with 20 using more than one kind, including dictionaries (n = 20), online videos (n = 7), and talking to friends (n = 6). Still, in her follow-up member checking interview Maxine reported discomfort with using her L1 publicly. In addition, she, Yang, and some survey respondents expressed fear that reliance on their L1 would lead to an inability to express their comprehension of biology content on the exams. It seems that if ISs are to access the resource that is their L1 effectively, they may need an endorsement of the practice from an authority figure, and they may also benefit from some guidance in how to do so effectively.

Allowing students to draw on their individual resources may also mean giving students some freedom to use their electronic devices in class. Some guidelines may be useful here as well, as these devices can prove distracting to the user and to neighbors (Hembrooke & Gay, 2003; Sana, Weston, & Cepeda, 2013), but in my classroom observations I occasionally saw students using L1 websites to find definitions and such, and I even witnessed what appeared to be texting as a means of communicating with peers around course content. In survey responses, eight students supported my observation of texting behavior, expressing that though they did not text frequently, on some occasions they did so for the purpose of discussing course content.

Accessing Additional Resources

Although Biology 101 provided students with numerous points of entry for content learning (e.g., textbook, lecture, discussion section, podcast, etc.) and a wealth of offerings for supplementary support (e.g. peer tutoring, office hours), ISs may need additional guidance if they are to get in the habit of accessing these various options effectively. For instance, TAs

might offer extra credit to students for attending their office hours in the first weeks. To help ISs acclimate to this practice, TAs might also provide them with explicit information regarding appropriate topics to discuss in office hours, ways of beginning and ending the visit, and so on (Snow, 1997). Naturally, an added benefit of these incentivized visits early in the term is that they allow the TAs and students to get to know one another from the outset, thus sensitizing TAs to ISs' needs and breaking the ice for future dialogue.

One parallel option that might prove even more useful and comfortable to ISs would be to enlist prior ISs who successfully completed the course as peer tutors. These tutors could provide targeted guidance to their less experienced peers and serve as role models, and they may be deemed more approachable than other authorities in the class. Incidentally, in her member checking interview Maxine reported that she had served as a peer tutor in her second year, and she shared that ISs indeed made use of the unique opportunity, as three Chinese students tended to visit her and communicated in their L1, so long as other local students were not around.

In a large class with several TAs, it may also be useful to assign one TA to hold office hours online for those students who feel more comfortable communicating in this fashion. In addition, ISs could benefit from expanded online resources, such as curated links to websites, vocabulary practice, and videos, as well as information about how to use the internet for effective study, as some students may be new to an internet that is not heavily regulated by the government (as Gladys noted, "In my country there's actually no videos on the internet but in America, yeah").

The important thing to bear in mind is that because these learners are heterogeneous, one size will not fit all when it comes to the kinds of support they will find useful. Thus, offering various avenues, and familiarizing students with these options, can increase ISs' success in learning the content.

Engaging the Aid of Language Professionals

Many of the practices described above could be supported and enhanced if content instructors and language instructors worked together, as in Snow, Met, and Genesee's conceptual framework for integrating language and content instruction (1989), reproduced in Figure 3.1. In addition, language instructors could help in the high structure course design, adding additional features to help students learn the meanings and pronunciation of new vocabulary, among other things. Such language teaching professionals could also provide support by vetting exam questions, providing IS workshops in textbook reading strategies, and offering ISs guidance in effective use of their L1.

Further Research

Classroom-based mixed methods studies of this nature often raise at least as many questions as they answer, and though there may be reason to be optimistic about the use of active learning to facilitate content learning for ISs, there is also need for further inquiry. Further research is necessary to better understand just what impact active learning has for this population. Some of the most useful investigations may be carried out through replications of prior influential studies on active learning in STEM that neglected to focus on ISs, ethnographic studies of ISs' ways of engaging in active learning of content, and experimental studies of other

instructional innovations in this context and their impact on this population. I propose some key questions and areas for further research below.

Replications

Though much research has been conducted on the use of active learning in STEM gateway courses, ISs have not been a focus. Therefore, a simple but important step further for research would be replication studies with the added element of collecting and analyzing data on this population. One study of particular interest for replication is Smith et al.'s (2009) investigation of what transpires during peer instruction. Whereas the students in Smith et al.'s study seemed to benefit regardless of whom they partnered with (i.e., regardless of whether one partner knew the correct answer or not), my study raises the possibility that for ISs, language issues may diminish the value of peer instruction. This concern is raised by Maxine's paradoxical accounts that she would talk a lot only if she were sitting with friends, but that even in those instances she might address the topic only superficially if she were sitting with a fellow IS, because her sense of obligation to use English in class conflicted with her feelings of awkwardness doing so with someone who shared her L1.

Language Skills and Language Use

ISs reported that their speaking, reading, and vocabulary skills were most strained in the course, and in some cases these were also the language skills that they felt had improved the most over the course of the quarter. Of course, ISs are not language experts, and these accounts offer little more than their perceptions of challenge and improvement. Studies using a pre-test/post-test design with random assignment of students to active learning intervention or traditional instruction, with controlled fidelity of implementation measures, would offer better

insights into the impact that such active learning of biology content might have on ISs' language development. A similar experimental design could be used to investigate ISs' reluctance to speak in class, as reported by both TAs and some ISs themselves, and the extent to which this reluctance might impact their content learning, via a comparison of the experiences and performances of ISs in a traditional course with those of ISs in a course that uses active learning.

Instructional Innovations and Support

Additional research might test instructional innovations aimed at enhancing ISs' engagement in active learning. For instance, in consideration of ISs' struggles with peer interaction, a focus on the impact of efforts at building community on students' engagement would be of interest. Further work might investigate the class-wide discussions that often take place during lectures in an active learning course. Though this teacher-student interaction is a hallmark of a course that breaks away from traditional modes of teacher-centered instruction, it poses significant challenges to students who cannot hear or understand their peers' unamplified and perhaps under-contextualized comments, which are typically unsupported by visuals. Research may examine instructional practices and learning strategies that can aid ISs' understanding of and engagement with these discussions.

Understanding ISs' Needs

Ethnographic research can provide insight on such topics as ISs' needs, their ways of engaging in the course, their use of their L1, and their use of strategies. Key questions related to L1 use include: How do ISs make use of their L1 in the course? In what ways does it serve as a useful resource, and in what ways might it act as a hindrance to their learning of biology

content in English? What strategies are most effective in helping ISs use their L1 as a resource for content learning in this context? Furthermore, perhaps an ideal opportunity for understanding the needs and strategies of Chinese ISs would be an analysis of their use of WeChat, examining what areas they seek help on, what kinds of help they provide, and what kinds of help they find useful.

Other Studies

Important work in the area of ISs and active learning could further be generated through studies that use variations and enhancements on the study here described. For instance, even in the pool of over 800 students in the biology course described here, with dozens of first-year ISs, it was difficult to find ISs who were willing to participate in interviews, and when the interviews did take place, language issues occasionally threatened to cause communication breakdowns between the interviewer and the interviewee. For these reasons, it might be better to conduct future research in this area with the aid of ISs as research assistants (RAs). In the undergraduate setting, the RAs might get independent study credit for attending training on interview-based research, and they would subsequently recruit fellow ISs for interviews, perhaps after conducting field observations of classes attended by large numbers of ISs. Though ISs were reluctant to agree to join me for interviews, I expect that these peer IS researchers might be more persuasive, and might even be able to get ISs to agree to being shadowed, which would offer further insights regarding ISs' strategies and needs. An added benefit of this RA-driven work is that if these students share the same L1 as their interviewees, the interviewee can have the option of using whichever language is most comfortable, which

will diminish the likelihood of communication breakdowns and enhance the chances of yielding deeper insights.

Another variation on the study here described would involve more cohorts of the biology class, amassing enough data on ISs to increase the likelihood of uncovering such associations as may exist between their survey response data and their scores in the course. Finally, similar investigation of the use of active learning in other contexts of content learning, both in the U.S. and abroad, could help determine the extent to which the impact of these practices as described here might extend to L2 users of English in other environments, such as English as a Medium of Instruction (EMI) and Content and Language Integrated Learning (CLIL) contexts.

Conclusion

ISs in a large, highly structured introductory biology course performed well in relation to their non-IS peers, but did not get grades commensurate with their academic ability as suggested by their SAT math scores. Language-related issues seemed to play a role in their reduced grades, and may have impacted the benefits they received from the course's heavy use of such active learning instructional practices as open discussion, clicker questions, peer instruction, small group work, and collaborative quizzes. Still, though ISs were at times reluctant to interact with peers, on the whole they reported that they held favorable views of these active learning practices, and they identified associations between active learning and their learning of content and language. Moreover, these ISs found high structure components such as reading guides and pre-class assignments essential to their success, and they adapted to the new academic culture with self-direction and a capacity to access supplementary resources.

ISs reported that the greatest language challenges posed by the course were related to vocabulary, speaking, and reading, and that such course components as pre-lecture lists of key terms, collaborative quizzes, and supplementary reading guides helped them address these challenges. In addition, the large lecture portion of the course, punctuated by occasions for students to talk to neighbors, afforded the students opportunities to draw on their L1 as a resource if they so desired. In short, though this large gateway course posed many unique challenges to ISs new to university studies, many of the innovative course components aimed at increasing the persistence and success of all students were regarded favorably by the ISs, and these components may have had a favorable impact on ISs' learning as well.

References

Abbott, A. (2004). *Methods of discovery: Heuristics for the social sciences*. New York: W. W. Norton & Company.

Airey, J. (2009). *Science, language, and literacy: Case studies of learning in Swedish university physics*. Uppsala, Sweden: Acta Universitatis Upsaliensis.

Airey, J. (2012). "I don't teach language." The linguistic attitudes of physics lecturers in Sweden. In U. Smit & E. Dafouz (Eds.), *Integrating content and language in higher education: Gaining insights into English-medium instruction at European universities (AILA, 25)* (pp. 64-79). Philadelphia, PA: John Benjamins.

Airey, J., & Linder, C. (2006). Language and the experience of learning university physics in Sweden. *European Journal of Physics*, *27*(3), 553-560. doi: 10.1088/0143-0807/27/3/009

Beatty, I. D., Gerace, W. J., Leonard, W. J., & Dufresne, R. J. (2006). Designing effective questions for classroom response system teaching. *American Journal of Physics, 74*(1), 31–39. https://doi.org/10.1119/1.2121753

Bonwell, C. C., & Eison, J. A. (1991). *Active learning: Creating excitement in the classroom. 1991 ASHE-ERIC higher education reports*. Washington, DC: ERIC Clearinghouse on Higher Education.

Bowers, C. A. (2005). *The false promises of constructivist theories of learning: A global and ecological critique* (Vol. 14). New York: Peter Lang.

Brame, C., (2016). Active learning. Retrieved from https://cft.vanderbilt.edu/active-learning/.

Brewer, C. A., & Smith, D. (2011). Vision and change in undergraduate biology education: A call to action. Final report of a national conference organized by the AAAS, July 15–17 2009. Washington, DC: American Association for the Advancement of Science.

Byun, K., Chu, H., Kim, M., Park, I., Kim, S., & Jung, J. (2011). English-medium teaching in Korean higher education: Policy debates and reality. *Higher Education*, *62*(4), 431-449. https://doi.org/10.1007/s10734-010-9397-4

Caldwell, J.E. (2007). Clickers in the large classroom: Current research and best-practice tips. *CBE Life Sciences Education 6*(1), 9–20. https://doi.org/10.1187/cbe.06-12-0205

Carr, R., Palmer, S., & Hagel, P. (2015). Active learning: The importance of developing a comprehensive measure. *Active Learning in Higher Education*, *16*(3), 173-186. doi: 10.1177/1469787415589529

Cech, T., & Kennedy, D. (2005). Doing more for Kate. *Science*, *310*(5755), 1741. doi: 10.1126/science.1123580

Chapelle, C. A. (2008). The TOEFL validity argument. In C. A. Chapelle, M. K. Enright, & J. M. Jamieson (Eds.), *Building a validity argument for the Test of English as a Foreign Language* (pp. 319-352). New York: Routledge.

Chromá, M. (2006). Assessing linguistic awareness in Czech legal education – a case of neglect? In R. Wilkinson, V. Zegers, & C. van Leeuwen (Eds.), *Bridging the assessment gap in English-medium higher education* (pp. 195-210). Maastricht: Maastricht University.

Coleman, J. A. (2006). English-medium teaching in European higher education. *Language Teaching*, *39*(1), 1–14. https://doi.org/10.1017/S026144480600320X

Cortright, R. N., Collins, H. L., Rodenbaugh, D. W., & DiCarlo, S. E. (2003). Student retention of course content is improved by collaborative-group testing. *Advances in Physiology Education*, *27*(3), 102-108. https://doi.org/10.1152/advan.00041.2002

Costa, F., & Coleman, J. (2010). Integrating content and language in higher education in Italy: Ongoing research. *International CLIL Research Journal*, *2010*(3), 19-29.

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications, Inc.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks, CA: Sage Publications, Inc.

Dearden, J. (2014). *English as a medium of instruction–a growing global phenomenon: Phase 1*: *Interim report.* London: British Council.

Dearden, J. (2015). *English as a medium of instruction–a growing global phenomenon:* London: British Council.

Denzin, N. K., & Lincoln, Y. S. (1994). *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications, Inc.

Dewey, J. (1924). *Democracy and Education*. New York: Macmillan.

Dillon, R. K., & Swann, J. S. (1997, November). *Studying in America: Assessing how uncertainty reduction and communication satisfaction influence international students' adjustment to U.S. campus life.* Paper presented at the 83rd Annual Meeting of the National Communication Association, Chicago, IL.

Disch, E. (2004). "Still cannot solve it": Engaging ESOL students in the classroom conversation. In V. Zamel & R. Spack (Eds.). *Crossing the curriculum: Multilingual learners in college classrooms* (pp. 197-206). Mahwah, NJ: Lawrence Erlbaum Associates.

Doiz, A., Lasagabaster, D., & Sierra, J. M. (2012). Future challenges for English-medium instruction at the tertiary level. In A. Doiz, D. Lasagabaster, & J. M. Sierra (Eds.), *English-medium instruction at universities: Global challenges* (pp. 213-221). Bristol, UK: Multilingual Matters.

Dörnyei, Z. (2007). *Research methods in applied linguistics: Qualitative, quantitative and mixed methodologies*. Oxford: Oxford University Press.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-273.

Eaton, T. T. (2009). Engaging students and evaluating learning progress using collaborative exams in introductory courses. *Journal of Geoscience Education 57*(2), 113–120. https://doi.org/10.5408/1.3544241

Educational Testing Service (ETS). (2010). *Linking TOEFL iBT scores to IELTS scores—A research report*. Princeton, NJ: Educational Testing Service. Retrieved from https://www.ets.org/s/toefl/pdf/linking_toefl_ibt_scores_to_ielts_scores.pdf

Educational Testing Service (ETS). (2017). *Test and score data summary for TOEFL iBT® tests: January 2016– December 2016 test data*. Princeton, NJ: Educational Testing Service. Retrieved from: https://www.ets.org/s/toefl/pdf/94227_unlweb.pdf

Fairweather, J. (2008). Linking evidence and promising practices in science, technology, engineering, and mathematics (STEM) undergraduate education: A status report for The

National Academies National Research Council Board of Science Education (BOSE). Washington, DC: The National Academies National Research Council Board of Science Education.

Feldman, M. S. (1995). *Strategies for interpreting qualitative data*. Thousand Oaks, CA: Sage Publications, Inc. http://dx.doi.org/10.4135/9781412986007

Ferris, D. (1998). Students' view of academic aural/oral skills: A comparative needs analysis. *TESOL Quarterly, 32*(2), 289–316. https://doi.org/10.2307/3587585

Ferris, D. (2009). *Teaching college writing to diverse student populations*. Ann Arbor, MI: University of Michigan Press.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

Freeman, S., O'Connor, E., Parks, J. W., Cunningham, M., Hurley, D., Haak, D., Dirks, C., & Wenderoth, M. P. (2007). Prescribed active learning increases performance in introductory biology. *CBE-Life Sciences Education*, *6*(2), 132-139. https://doi.org/10.1187/cbe.06-09-0194

Freeman, S., Haak, D., & Wenderoth, M. P. (2011). Increased course structure improves performance in introductory biology. *CBE-Life Sciences Education*, *10*(2), 175-186. https://doi.org/10.1187/cbe.10-08-0105

García, O., Johnson, S.I., & Seltzer, K. (2016). *The translanguaging classroom: Leveraging student bilingualism for learning*. Philadelphia: Caslon.

García, O., & Kleyn, T. (2016). *Translanguaging with multilingual students: Learning from classroom moments*. New York: Routledge.

García, O., & Sylvan, C. E. (2011). Pedagogies and practices in multilingual classrooms: Singularities in pluralities. *The Modern Language Journal*, *95*(3), 385-400. https://doi.org/10.1111/j.1540-4781.2011.01208.x

García, O. & Wei, L. (2014). *Translanguaging: Language, bilingualism and education*. London: Palgrave MacMillan.

Glass, C. R., Wongtrirat, R., & Buus, S. (2015). *International student engagement: Strategies for creating inclusive, connected, and purposeful campus environments*. Sterling, VA: Stylus Publishing, LLC.

Goldstein, L., (2017). Looking back and looking forward at the adjunct model: Are we still smiling through the turbulence? In M. A. Snow & D. Brinton (Eds.), *The content-based classroom: New perspectives on integrating language and content* (2nd Ed) (pp. 338-351). Ann Arbor, MI: University of Michigan Press.

Guilloteaux, M. J., & Dörnyei, Z. (2008). Motivating language learners: A classroom-oriented investigation of the effects of motivational strategies on student motivation. *TESOL Quarterly*, *42*(1), 55-77. https://doi.org/10.1002/j.1545-7249.2008.tb00207.x

Haak, D. C., HilleRisLambers, J., Pitre, E., & Freeman, S. (2011). Increased structure and active learning reduce the achievement gap in introductory biology. *Science*, *332*(6034), 1213-1216. doi: 10.1126/science.1204820

Hamrick, J. (2013, February 17). *Computing multicollinearity diagnostics in Stata*. [Video file]. Retrieved from https://www.youtube.com/watch?v=jo-es2s6Xpw

Harklau, L. (2000). From the “good kids” to the “worst”: Representations of English language learners across educational settings. *TESOL Quarterly*, *34*(1), 35–67. doi: 10.2307/3588096.

Hatch, J. A. (1985). The quantoids versus the smooshes: Struggling with methodological rapprochement. *Issues in Education*, *3*(2), 158-67.

Hatch, J. A. (2002). *Doing qualitative research in education settings*. Albany, NY: SUNY Press.

Heikinheimo, P.S., & Shute, J.C. (1986). The adaptation of foreign students: Student views and institutional implications. *Journal of College Student Personnel 27*(5), 399-406.

Hembrooke, H. & Gay, G. (2003). The laptop and the lecture: The effects of multitasking in learning environments. *Journal of Computing in Higher Education*, 15(1), 46-64. https://doi.org/10.1007/BF02940852

Hornberger, N., & Vaish, V. (2009). Multilingual language policy and school linguistic practice: Globalization and English-language teaching in India, Singapore and South Africa. *Compare*, *39*(3), 305-320. https://doi.org/10.1080/03057920802469663

Hu, G. (2002). Potential cultural resistance to pedagogical imports: The case of communicative language teaching in China. *Language, Culture and Curriculum,15*(2), 93-105. https://doi.org/10.1080/07908310208666636

Huang, D. F. (2015). Exploring and assessing effectiveness of English-medium instruction courses: The students’ perspectives. *Procedia – Social and Behavioural Sciences 173,* 71-78. https://doi.org/10.1016/j.sbspro.2015.02.033

Hurtado, S., & Kamimura, M. (2004). Latina/o retention in four-year institutions. In J.

Castellanos & L. Jones (Eds.), *The majority in the minority: Expanding the representation of Latina/o faculty, administrators, and students in higher education,* (pp. 139-150). Sterling, VA: Stylus Publishing, LLC.

Institute of International Education (2016). Open doors 2016 executive summary. Retrieved from http://www.iie.org/Who-We-Are/News-and-Events/Press-Center/Press-Releases/2016/2016-11-14-Open-Doors-Executive-Summary#.WKR-bPkrJPY

Jackson, J. (2002). Reticence in second language case discussions: Anxiety and aspirations. *System*, *30*(1), 65-84. https://doi.org/10.1016/S0346-251X(01)00051-3

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2017). *An introduction to statistical learning* (8th ed.). New York: Springer.

Jones, R., & Kim, Y. S. (2013). Communication experiences of international students in the U.S.: A comparison study of cross-cultural adaptation between European and Asian students. *Scientia et Humanitas*, *3*, 83-104.

Kanno, Y., & Varghese, M. M. (2010). Immigrant and refugee ESL students' challenges to accessing four-year college education: From language policy to educational policy. *Journal of Language, Identity, and Education*, *9*(5), 310-328. https://doi.org/10.1080/15348458.2010.517693

Klaassen, R. G., & De Graaff, E. (2001). Facing innovation: Preparing lecturers for English-medium instruction in a non-native context. *European Journal of Engineering Education*, *26*(3), 281-289. https://doi.org/10.1080/03043790110054409

Knight, J. K., & Wood, W. B. (2005). Teaching more by lecturing less. *Cell Biology Education*, *4*(4), 298-310. https://doi.org/10.1187/05-06-0082

Koch, N., Krilowicz, B., Srole, C., Galanti, G., Kamhi-Stein, L. D., & Snow, M. A. (1997). The multistep writing assignment. In D. Brinton & P. Master (Eds.), *New ways in content-based instruction* (pp. 243–257). Alexandria, VA: TESOL.

Kopf, D. (2016, November 30). Trump is threatening to bar the million international students that U.S. colleges need to subsidize tuitions each year. *Quartz*. Retrieved from https://qz.com/849612/china-sends-330000-students-to-the-us-each-year-and-trump-could-change-that/

Kothiyal, A., Murthy, S., & Iyer, S. (2014, June). Think-pair-share in a large CS1 class: Does learning really happen? In M. Goldweber (Ed.), *Proceedings of the 2014 Conference on Innovation & Technology in Computer Science Education* (pp. 51-56). Uppsala, Sweden: ACM. https://doi.org/10.1145/2591708.2591739

Kroll, J. F., & Bialystok, E. (2013). Understanding the consequences of bilingualism for language processing and cognition. *Journal of Cognitive Psychology*, *25*(5), 497-514. https://doi.org/10.1080/20445911.2013.799170

Kuh, G., Kinzie, J., Schuh, J., & Witt, E. (2005). *Student success in college: Creating conditions that matter*. San Francisco: Jossey-Bass.

Lasry, N., Mazur, E., Watkins, J. (2008). Peer instruction: from Harvard to the two-year college. *American Journal of Physics, 76*(11), 1066–1069**.** https://doi.org/10.1119/1.2978182

Lavrakas, P. J. (2008). *Encyclopedia of survey research methods.* Thousand Oaks, CA: Sage Publications Inc. doi: 10.4135/9781412963947

Leki, I. (1992). *Understanding ESL writers: A guide for teachers*. Portsmouth, NH**:** Heinemann

Levine, G. (2011). *Code choice in the language classroom*. Bristol, UK: Multilingual Matters.

Li, X.J. (1984). In defence of the communicative approach. *ELT Journal, 38*(1), 2–13. https://doi.org/10.1093/elt/38.1.2

Lin, A. C. (1998). Bridging positivist and interpretive approaches to qualitative methods. *Policy Studies Journal, 26*(1): 162-180. https://doi.org/10.1111/j.1541-0072.1998.tb01931.x

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Thousand Oaks, CA: Sage Publications, Inc.

Locke, K. (2001). *Grounded theory in management research*. Thousand Oaks, CA: Sage Publications, Inc. http://dx.doi.org/10.4135/9780857024428

Locke, K. & Golden-Biddle, K. (2002). An introduction to qualitative research: Its potential for industrial and organizational psychology. In S. G. Rogelberg (Ed.), *Handbook of research methods in industrial and organizational psychology* (pp.99-118). Malden, MA: Blackwell.

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2010). *Methods in educational research: From theory to practice* (2nd ed.). San Francisco, CA: Jossey-Bass.

Lu, Y. (2002). *Communication strategies used by Chinese graduate students in a study abroad*

academic context (Unpublished doctoral dissertation). Queen's University at Kingston, Canada.

Marsh, C. (1991). Implementation. In C. Marsh & P. Morris (Eds.), *Curriculum Development in East Asia*. London: The Falmer Press.

Marsh, D., & Laitinen, J. (2005). Medium of instruction in European higher education: Summary of research outcomes of European Network for language learning amongst undergraduates (ENLU) Task Group 4. Jyvaskyla: Uni COM, University of Jyvaskyla.

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Muñoz, M. (2004). Martha's reflections on learning across the curriculum. In V. Zamel & R. Spack (Eds.). *Crossing the curriculum: Multilingual learners in college classrooms* (pp. 97-110). Mahwah, NJ: Lawrence Erlbaum Associates.

NAFSA Association of International Educators (2016). NAFSA international student economic value tool. Retrieved from http://www.nafsa.org/Policy_and_Advocacy/Policy_Resources/Policy_Trends_and_Data/NAFSA_International_Student_Economic_Value_Tool/

Núñez, A. M., Rios-Aguilar, C., Kanno, Y., & Flores, S. M. (2016). English learners and their transition to postsecondary education. In J.C. Smart (Ed.), *Higher education: Handbook of theory and research* (pp. 41-90). Cham: Springer.

Olson, S., & Riordan, D. G. (2012). Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics. Report to the President. Washington, DC: Executive Office of the President.

Pascarella, E., & Terenzini, P. (2005). *How college affects students: A third decade of research*. San Francisco: Jossey-Bass.

Patton, M. Q. (2015). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice* (4th ed.). Thousand Oaks, CA: Sage Publications, Inc.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, *93*(3), 223-231. https://doi.org/10.1002/j.2168-9830.2004.tb00809.x

Ramsay, S., Barker, M., & Jones, E. (1999). Academic adjustment and learning processes: A comparison of international and local students in first-year university. *Higher Education Research & Development, 18*(1), 129-144. https://doi.org/10.1080/0729436990180110

Rao, S. P., Collins, H. L., & DiCarlo, S. E. (2002). Collaborative testing enhances student learning. *Advances in Physiology Education*, *26*(1), 37-41. https://doi.org/10.1152/advan.00032.2001

Rea-Dickens, P. (2014). *English medium examining of school subject knowledge: Perpetuating social and economic exclusion* [PowerPoint slides]. Retrieved from www.education.ox.ac.uk/wordpress/wp-content/uploads/2014/03/Pauline-Rea-Dickins-presentation.pdf

Reid, J. M. (1997). Which non-native speaker? Differences between international students and U.S. resident (language minority) students. *New Directions for Teaching and Learning, 70,* 17–27. https://doi.org/10.1002/tl.7002

Robinson, J. P. (2010). The effects of test translation on young English learners' mathematics performance. *Educational Researcher*, *39*(8), 582-590. https://doi.org/10.3102/0013189X10389811

Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: Association for Supervision and Curriculum Development.

Ruiz-Primo, M.A., Briggs, D., Iverson, H., Talbot, R., & Shepard, L.A. (2011). Impact of undergraduate science course innovations on learning. *Science 331*(6022), 1269–1270.

Ryan, J. (2007). The student experience: Challenges and rewards. In J. Carroll & J. Ryan (Eds.), *Teaching international students: Improving learning for all* (pp. 147-152). New York: Routledge.

Sadler, P. M., & Tai, R. H. (2007). Advanced placement exam scores as a predictor of performance in introductory college biology, chemistry and physics courses. *Science Educator*, *16*(2), 1-19. doi: 10.1126/science.1198976

Saldaña, J. (2012). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications, Inc.

Sana, F., Weston, T., & Cepeda, N. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education*, *62*, 24-31. https://doi.org/10.1016/j.compedu.2012.10.003

Saul, S. (2018, January 2). As flow of foreign students wanes, U.S. universities feel the sting. *New York Times*. Retrieved from https://www.nytimes.com/2018/01/02/us/international-enrollment-drop.html

Seymour E., & Hewitt N. (1997). *Talking about leaving: Why undergraduates leave the sciences*, Boulder, CO: Westview Press**.**

Shi, L. (2006). The successors to Confucianism or a new generation? A questionnaire study on Chinese students' culture of learning English. *Language, Culture and Curriculum*, *19*(1), 122-147. https://doi.org/10.1080/07908310608668758

Shohamy, E. (2012). A critical perspective on the use of English as a medium of instruction at universities. In A. Doiz, D. Lasagabaster, & J. M. Sierra (Eds.), *English-medium instruction at universities: Global challenges* (pp. 196-210). Bristol, UK: Multilingual Matters.

Smith, K. (2004). Studying in an additional language: What is gained, what is lost and what is assessed. In R. Wilkinson (Ed.), *Integrating content and language: Meeting the challenge of a multilingual higher education* (pp. 78-93). Maastricht, The Netherlands: Universitaire Pers Maastricht.

Smith, K. A., Sheppard, S. D., Johnson, D. W., & Johnson, R. T. (2005). Pedagogies of engagement: Classroom-based practices. *Journal of Engineering Education*, *94*(1), 87-101. https://doi.org/10.1002/j.2168-9830.2005.tb00831.x

Smith, M. K., Wood, W. B., Adams, W. K., Wieman, C., Knight, J. K., Guild, N., & Su, T. T. (2009). Why peer discussion improves student performance on in-class concept questions. *Science*, *323*(5910), 122-124. doi: 10.1126/science.1165919

Snow, M. A. (1997). Teaching academic literacy skills: Discipline faculty take responsibility. In M. A. Snow & D. Brinton (Eds.), *The content-based classroom: Perspectives on integrating language and content* (pp. 290-304). New York: Longman.

Snow, M. A., Met, M., & Genesee, F. (1989). A conceptual framework for the integration of language and content in second/foreign language instruction. *TESOL Quarterly*, *23*(2), 201-217. https://doi.org/10.2307/3587333

Spradley, J. (1979). *The ethnographic interview*. New York: Holt, Rinehart and Winston.

Springer, L., Stanne, M.E., & Donovan, S.S. (1999). Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology. *Review of Educational Research 69*(1), 21–51. https://doi.org/10.3102/00346543069001021

Srole, C. (1997). Pedagogical responses from content faculty: Teaching content and language in history. In M. A. Snow & D. Brinton (Eds.), *The content-based classroom: Perspectives on integrating language and content* (pp. 104-116). New York: Longman.

Stillwell, C. (2017). Supporting lecturers and learners in the use of English as medium of instruction. In M. A. Snow & D. Brinton (Eds.), *The content-based classroom: Perspectives on integrating language and content* (2nd ed.) (pp. 228-241). Ann Arbor, MI: University of Michigan Press.

Swain, M., Kirkpatrick, A., & Cummins, J. (2011). *How to have a guilt-free life using Cantonese in the English class.* Hong Kong: Research Centre into Language Education and Acquisition in Multilingual Societies, Institute of Education.

Tan, M. (2011). Mathematics and science teachers' beliefs and practices regarding the teaching of language in content learning. *Language Teaching Research*, *15*(3), 325-342. https://doi.org/10.1177/1362168811401153

Tanner, K. D. (2012). Promoting student metacognition. *CBE-Life Sciences Education*, *11*(2), 113-120. https://doi.org/10.1187/cbe.12-03-0033

Taylor, C., & Angelis, P. (2008). The evolution of the TOEFL. In C. A. Chapelle, M. K. Enright, & J. M. Jamieson (Eds.), *Building a validity argument for the Test of English as a Foreign Language* (pp. 27-54). New York: Routledge.

Unterberger, B., & Wilhelmer, N. (2011). English-medium education in economics and business studies: Capturing the status quo at Austrian universities. *ITL International Journal of Applied Linguistics*, *161*, 90–110.

van der Walt & Kidd, (2012). Acknowledging academic biliteracy in higher education assessment strategies: A tale of two trials. In A. Doiz, D. Lasagabaster, & J. M. Sierra (Eds.), *English-medium instruction at universities: Global challenges* (pp. 27-43). Bristol, UK: Multilingual Matters.

van Lier, L. (2005). The bellman's map: Avoiding the "perfect and absolute blank" in language learning. In R. M. Jourdenais & S. E. Springer (Eds.), *Content, tasks and projects in the language classroom: 2004 conference proceedings* (pp. 13–22). Monterey, CA: Monterey Institute of International Studies.

Vaughan, D. (1992). Theory elaboration: The heuristics of case analysis. In C. C. Ragin & H. S. Becker (Eds.), *What is a case? Exploring the foundations of social inquiry* (pp. 173-202). Cambridge: Cambridge University Press.

Wang, Y. (2003). *The contextual knowledge of language and culture: Exploring the American academic experiences of Chinese graduate students* (Unpublished doctoral dissertation). The University of Southern Mississippi.

Wankat, P., & Oreovicz, F. (1998). Content tyranny. *ASEE Prism*, *8*(2), 15. https://search.proquest.com/docview/236160051?accountid=14509

Wischusen, S. M., Wischusen, E. W. (2007). Biology intensive orientation for students (BIOS): A biology "boot camp." *CBE Life Sciences Education 6*(2), 172–178**.** https://doi.org/10.1187/cbe.06-08-0184

Wright, W. (2010). *Foundations for teaching English language learners: Research, theory, policy, and practice*. Philadelphia: Caslon Publishing.

Yan, K., & Berliner, D. C. (2016). The unique features of Chinese international students in the United States. In S. Guo & Y. Guo (Eds.) *Spotlight on China* (pp. 129-150). Rotterdam: Sense Publishers.

Yeh, C. C. (2014). Taiwanese students' experiences and attitudes towards English-medium courses in tertiary education. *RELC Journal*, *45*(3), 305-319. https://doi.org/10.1177/0033688214555358

Zamel, V. (2004). Strangers in academia: The experiences of faculty and ESOL students across the curriculum. In V. Zamel & R. Spack (Eds.), *Crossing the curriculum: Multilingual learners in college classrooms* (pp. 3-17). Mahwah, NJ: Lawrence Erlbaum Associates.

Zhao, C. M., Kuh, G. D., & Carini, R. M. (2005). A comparison of international student and American student engagement in effective educational practices. *The Journal of Higher Education, 76*(2), 209-231. doi: 10.1080/00221546.2005.11778911

Appendix A: Post-Course Survey: Course Component Evaluation

1. What version of the textbook did you use this quarter?

    a. Primarily the physical textbook

    b. Primarily the eTextbook

    c. About 50/50 of each

    d. I did not use a textbook

2. What did you buy for this class?

    a. The custom physical textbook plus *Mastering Biology* access (bought at the university bookstore)

    b. The eTextbook plus *Mastering Biology* access (bought at the university bookstore)

    c. The eTextbook *Mastering Biology* access (bought online)

    d. Other

3. Do you plan on selling back your physical textbook or keeping it?

    a. Selling it

    b. Keeping it

    c. I did not buy a physical textbook for this class

4. What was the most useful part of the class in terms of learning the course material? Select one.

    a. Textbook alone

    b. Textbook + reading guides

    c. In-class lessons

d. *Mastering Biology*

e. Discussion sections

5. What best describes your use of the reading guides?

a. I complete the reading guides every day before doing the pre-class *Mastering Biology* assignments.

b. I complete the reading guides sometimes, but not all of the time, before doing the pre-class *Mastering Biology* assignments.

c. I complete the reading guides after class, not before.

d. I do not complete the reading guides at all.

6. How much total time did you typically spend completing the pre-class reading guides?

a. 0 to 30 minutes

b. 30 to 60 minutes

c. 60 to 90 minutes

d. 90 to 120 minutes

e. Two to three hours

f. Three+ hours

7. Did you complete the reading guides before each day of class?

a. Never

b. Rarely

c. Sometimes

d. Often

e. All of the time

8. Did you watch the videos that were in the *Mastering Biology* pre-class assignments?

a. All of the time

b. Often

c. Sometimes

d. Rarely

e. Never

9. On the first day of class, after the first midterm, and throughout the course, Dr. Sherman shared advice about how to study. How important was this advice to you?

a. Very unimportant

b. Unimportant

c. Neither important nor unimportant

d. Important

e. Very important

10. If you could take this class again, which option would you prefer?

a. No discussion sections

b. Optional discussion sections

c. Required discussion sections

11. If you could take this class again, which option would you prefer for completing worksheets during discussion sections?

a. Working in the same group of 3-4 students every week

b. Working in a different group of 3-4 students every week

c. Working alone

12. How many new friends or acquaintances did you get from attending Bio 101 lectures and discussion sections?

a. 0
b. 1-2
c. 3-4
d. 5-6
e. 7 or more

13.Think about your performance in this class and how much you have learned. How do you think you would have performed in this class if you did **NOT** have...

13.1. A textbook

a. Much better
b. A little better
c. About the same
d. A little worse
e. A lot worse

13.2. Reading guides

a. Much better
b. A little better
c. About the same
d. A little worse
e. A lot worse

13.3. *Mastering Biology* pre-class assignments

a. Much better

b. A little better

c. About the same

d. A little worse

e. A lot worse

13.4. *Mastering Biology* weekly review quizzes

a. Much better

b. A little better

c. About the same

d. A little worse

e. A lot worse

13.5. Lecture with Dr. Sherman

a. Much better

b. A little better

c. About the same

d. A little worse

e. A lot worse

13.6. Discussion sections

a. Much better

b. A little better

c. About the same

d. A little worse

e. A lot worse

14.How important or unimportant were the following components / activities to your learning of the course material? Respond using the following scale below, where “A” indicates “Very unimportant” and “E” indicates “Very important.” Bubble in the appropriate choice.

14.1. Listening to lectures given by Dr. Sherman in class

14.2. Interacting with your neighbors in class

14.3. Answering clicker questions in class

14.4. Answering open-ended questions in class

14.5. Having learning objectives with each lesson

14.6. Having Bloom’s numbers (1, 2, 3) on slides in class

14.7. Attending office hours

14.8. Studying for exams

14.9. Reading the textbook

14.10. Completing the textbook reading guides

14.11. Doing the Mastering pre-class assignments

14.12. Doing the Mastering weekly quizzes

14.13. Using the Mastering Study Area

14.14. Doing the Mastering Adaptive Follow-Up assignments

14.15. Working in discussion sections

14.16. Attending LARC tutoring

14.17. Attending Bio Sci peer tutoring

14.18. Study skills workshop (Friday of week five in class)

14.19. Kahoot!

14.20. EASE supplemental instruction sessions

14.21. Answering clicker questions a second time after talking to a neighbor

14.22. Gesturing with our hands to act out things (e.g., fatty acid tails, phases of meiosis)

14.23. Watching videos in class

14.24. Watching podcasts of Dr. Sherman's lectures (University Replay)

15. Please select D for this question and continue.

16. How did you take notes in class?

    a. I printed the slides out and took notes on them
    b. I took notes on a laptop computer
    c. I took notes on a tablet (iPad, etc)
    d. I took notes on blank paper
    e. I didn't take notes

17. Did you use a laptop during class?

    a. Yes
    b. No

18. Were you distracted by having your laptop out during class?

    a. Never
    b. Rarely
    c. Sometimes
    d. Often

e. All of the time

19. Do you have a smartphone?

a. Yes, an iPhone

b. Yes, an Android phone

c. Yes, a Windows phone

d. No, I do not have a smartphone

20. Did you send text messages during class?

a. Never

b. Rarely

c. Sometimes

d. Often

e. All of the time

21. If you sent text messages during class, how often were your texts about something directly related to class?

a. Never

b. Rarely

c. Sometimes

d. Often

e. Always

22. Did you talk with your neighbor when instructed to do so during class activities?

a. Never

b. Rarely

c. Sometimes

d. Often

e. All of the time

f. I did not attend class

23. When Dr. Sherman took questions from students, what did you do? (Check all that apply)

a. Listen

b. Take notes

c. Look at notes or other materials related to the class

d. Talk to a classmate

e. Do something unrelated to class (e.g., texting, Facebook, work for another class)

24. When Dr. Sherman took questions from students, how often did you pay close attention?

a. Never

b. Rarely

c. Sometimes

d. Often

e. All of the time

25. How often did you check Piazza?

a. Every day

b. A few times a week

c. About once a week

d. Less than once a week

e. Never

26. What did you think of Kahoot!?

    a. It was fun and an effective way to learn.

    b. It was not fun but was an effective way to learn.

    c. It was fun and but was not an effective way to learn.

    d. It was not fun and was not an effective way to learn.

27. How often do you think we should play Kahoot!?

    a. Every day

    b. Once a week

    c. Once a month

    d. Once a quarter

    e. Never

28. Did you use any of these resources this quarter? Select all that you used at least once.

    a. Dr. Sherman's office hours

    b. TA office hours

    c. Bio Sci Peer Tutoring

    d. LARC

    e. Piazza

    f. *Mastering Biology* Study Area – practice quizzes and tests

    g. *Mastering Biology* Study Area – BioFlix videos

    h. *Mastering Biology* Adaptive Follow Up Assignments

    i. *Mastering Biology* Dynamic Study Modules

    j. Khan Academy

k. Other online biology videos

l. Podcasts of Dr. Sherman's lectures (University Replay)

29. Only answer this question if you were in the EASE program. What did you think of the EASE program? Did it help you succeed in Bio 101 this fall? Why or why not? What would you change about the EASE program?

30. How often did you attend each of the following types of sessions?

30.1. Professor Office Hours

a. Never

b. Once a quarter

c. Once a month

d. Once every two weeks

e. Once a week

f. More than once a week

30.2. Teaching Assistant (TA) Office Hours

a. Never

b. Once a quarter

c. Once a month

d. Once every two weeks

e. Once a week

f. More than once a week

30.3. Discussion Sections

a. Never

b. Once a quarter

c. Once a month

d. Once every two weeks

e. Once a week

f. More than once a week

30.4. Biological Sciences Peer Tutoring Office Hours

a. Never

b. Once a quarter

c. Once a month

d. Once every two weeks

e. Once a week

f. More than once a week

31. Did you attend each type of session at least one time during the course?

a. Yes

b. No

32. If you did not attend these additional sessions, why not? Please be specific for each type of session that you did not attend.

33.How approachable were the instructors of each of the following types of sessions?

33.1. Professor office hours

a. Not very approachable

b. Very approachable

33.2. Teaching assistant office hours

a. Not very approachable

b. Very approachable

33.3. Discussion sections

a. Not very approachable

b. Very approachable

33.4. Biological Sciences Peer Tutoring office hours

a. Not very approachable

b. Very approachable

34. How valuable were each of the following types of sessions towards helping you learn the course material in Bio Sci 101? Please also include your reason for why you thought so.

34.1. Professor office hours

a. Not very valuable

b. -

c. -

d. -

e. Very valuable

34.2. Please explain your reasoning.

34.3. Teaching assistant office hours

a. Not very valuable

b. -

c. -

d. -

e. Very valuable

34.4. Please explain your reasoning.

34.5. Discussion sections

a. Not very valuable

b. -

c. -

d. -

e. Very valuable

34.6. Please explain your reasoning.

34.7. Biological Sciences Peer Tutor office hours

a. Not very valuable

b. -

c. -

d. -

e. Very valuable

34.8. Please explain your reasoning.

35. Which type of session was most important to your success in the course? You can select only one type. Please elaborate why you chose that option.

a. Professor Office Hours

b. Teaching Assistant office hours

c. Discussion sections

d. Biological Sciences Peer Tutor office hours

36. Please explain your reasoning for your answer to the previous question.

37. Was English the primary language spoken at home when you grew up?

a. Yes

b. No

38. If you did not speak English at home growing up, what language did you speak?

39.The following three questions are for students whose first language is not English. Only answer if English is not your first language.

39.1. What aspects of this course helped you develop your English skills the most?

39.2. What is the most difficult thing about studying biology in English?

39.3. What resources did you use in another language to help you in this course? Select all that you used at least once.

a. Videos in a language other than English

b. Dictionary (e.g., Chinese-English dictionary, Vietnamese-English dictionary, Spanish-English dictionary, etc)

c. Talking to friends in a language other than English

d. Other resources in a language other than English (Please specify below)

39.4. Other resources from previous question

40. What advice would you give a student taking Bio 101 with Dr. Sherman in the future?

41. What is the most important thing that you learned in class this quarter?

42. Do you have any other comments about your experience in Bio 101 that you would like to share?

43. On the first day of class, after the first midterm, and throughout the course, Dr. Sherman shared advice about how to study. How important was this advice to you?

a. Very unimportant
b. Unimportant
c. Neither important nor unimportant
d. Important
e. Very important

Appendix B: Student Interview Protocol

Preliminaries

Why is (she) taking Bio 101? (Is (she) a Bio major?)

Ask about (her) class schedule, ask about other classes (she) takes

Academic English? Chemistry?

How long has (she) been in the U.S.? Why studying here? What do you hope to do in the future?

IS Background

How long has (she) been studying English?

In biology class, the teacher is not teaching English. The teacher is using English to teach something else – biology. Did you ever take any other classes in English before you came here?

How do you feel about your English skills? Do you feel like you are finished learning English?

Do you have any particular language learning goals?

How do you continue to learn language? Does this class help you in any way?

As someone who speaks ESL, what are some challenges that you face in your classes?

(during lectures?) (What challenges are related to language?)

The Course

Pretend I had never seen the class before, and don't know anything about it. Can you tell me about it?

What do you think about ___

-use of clickers

-using clicker 2nd time on same question

-explaining processes, diagrams to neighbors

-doing a graph in the air, doing the finger dance for chromosomes, voting one or two

-Teacher taking questions from students

-Teacher taking student answers to questions

-seeing peers' responses to three midterm questions on how much they study, starting when, etc.

-Bloom's #s

-podcasts

What do you like/dislike about each of these?

Why do you think the teacher uses these techniques?

How does this course differ from other lecture courses? What works best for you?

-What are your thoughts on a class in Bio 101 style vs. a class where the teacher talks all the time and does not use clickers and students do not talk to each other?

-Is there anything about this class that you think is particularly good or bad for people who speak ESL? (Have you noticed anything about Bio 101 that helps you improve your English language skills?)

How do you study? (Which of the class resources are best? (*Mastering Biology*, videos, Piazza, etc.)) Do you use any additional resources that are in (Chinese)?

Do you go to office hours? Peer study group? ISTEPS? If so, can you tell me anything about them?

Comprehension and Strategies

Sometimes the teacher makes comments at the start of class, and sometimes students laugh. Have you noticed? What kinds of things do they laugh about?

What about when the teacher talks about his family?

Are there ever times when you come across something that is hard to understand? What do you do?

Acquaintances

How many new acquaintances have you made?

How many students' names do you know in Bio 101 that you did not know before? How did you meet?

Discussion Section

Who is your TA?

Tell me about a typical discussion section. What happens?

How do you form groups?

How do you feel about working in these groups?

Does your teacher have you mix groups every week? Would you rather not?

What kind of role do you play in the group? (Lead, follow, work together, quiet, active?)

Have you made any new friends or acquaintances from the discussion section?

Pair Work

What do you do during the class? (e.g., talk to partner, take notes (how?), use phone/laptop (for what?))

What do you typically do when the teacher asks you to talk to a neighbor? Are there times when you don't do it? Why?

What about the times when you do talk - do you talk to someone you already know?

Do you ever use your L1 as a part of anything you do in this class? (As part of your class participation? As a part of your studies?)

Did you ever study English here in the U.S., or only back in (China)?

In the discussion section, you have to spend a lot of time working with partners. Was there anything similar when you were studying English in English classes?

What do you do when the teacher takes a question from a student?

What do you do when the teacher goes through opening slides (objectives, key words, faculty feature)?

What advice would you give to someone from your hometown who was planning to come to this university next year? What would you tell them about how to study and how to succeed in your classes?

How well do you think you are doing in the class?

Do you ever use your computer or phone to look at things other than the PowerPoint during class? If so, can you tell me what you use it for?

How do you get ready for tests?

Anything else you can add?

(Can you recommend others to talk to me?)

Appendix C: Correlation Matrix

Table C1 Correlation matrix

	Biology score	SAT Total	SAT Math	SAT Verbal	SAT Writing
Biology score	1				
SAT Total	.565***	1			
SAT Math	.488***	.776***	1		
SAT Verbal	.439***	.820***	.370***	1	
SAT Writing	.456***	.861***	.503***	.646***	1
Active Learning Composite	.00130	-.0573	-.0829*	-.0367	-.0160
Peer Interaction Important	-.00114	-.0588	-.0657	-.0589	-.0152
Clicker Important	.0390	-.00742	-.0482	.0144	.0199
Lecture Q&A Important	.0411	-.00915	-.0244	.00267	.000816
Kahoot! Important	-.0434	-.0984**	-.103**	-.0850*	-.0492
Peer Instruction Important	-.0376	-.0562	-.109**	-.00151	-.0234
Male	.158***	.127***	.161***	.0945*	.0468
Asian	.109	.235***	.400***	-.0151	.127
Hispanic	-.270***	-.393***	-.389***	-.264***	-.307***
White	.0789*	.0869*	-.0130	.148***	.0825*
Black	-.0130	-.0648	-.110**	-.00746	-.0378
Other	.0212	.0316	.0721	-.0102	.00245
Age	-.0110	-.00215	.0284	-.00417	-.0343
1st Generation	-.180***	-.330***	-.326***	-.201***	-.282***
Low SES	-.182***	-.320***	-.277***	-.196***	-.316***
Chinese Language	-.0366	.0156	.0180	.0214	-.00342
English Language	.0377	.136***	-.00911	.195***	.158***
Spanish Language	-.0593	-.0150	-.0218	.00810	-.0237
Multiple Languages	-.0148	.0343	.0310	.0203	.0327

* p<.05 ** p<.01 *** p<.001

Table C1 Correlation matrix (continued)

	Active Learning Composite	Peer Interaction Important	Clicker Important	Lecture Q&A Important	Kahoot! Important	Peer Instruction Important
Active Learning Composite	1					
Peer Interaction Important	.818***	1				
Clicker Important	.842***	.626***	1			
Lecture Q&A Important	.821***	.632***	.690***	1		
Kahoot! Important	.711***	.411***	.473***	.413***	1	
Peer Instruction Important	.811***	.574***	.632***	.556***	.510***	1
Male	-.0769*	-.0808*	-.109**	.00193	-.0835*	-.0506
Asian	.0557	.0781	.0407	-.00422	.0346	.0431
Hispanic	-.0286	-.0537	-.0441	-.0675	.0214	.0291
White	.0340	.0305	.0426	.0584	.00563	.00210
Black	.0307	.0175	.00184	.0661	.0399	-.00577
Other	.0758	.0863	.0348	.0123	.0657	.0945
Age	-.0814*	-.0620	-.0797*	-.0558	-.0390	-.0900*
1st Generation	.112**	.0446	.0798*	.0998**	.114**	.113**
Low SES	.0520	.0471	.00332	.0511	.0635	.0394
Chinese Language	.0924*	.0659	.122**	.0612	.0474	.0800*
English Language	-.0906*	-.0470	-.0707	-.106**	-.0820*	-.0571
Spanish Language	.0929*	.0666	.121**	.0569	.0515	.0838*
Multiple Languages	-.0583	-.0178	-.0489	-.0896*	-.0157	-.0673

* p<.05 ** p<.01 *** p<.001"

Table C1 Correlation matrix (continued)

	Male	Asian	Hispanic	White	Black	Other
Male	1					
Asian	.00256	1				
Hispanic	-.0452	-.553***	1			
White	.00428	-.420***	-.168***	1		
Black	-.0401	-.311***	-.155***	-.0471	1	
Other	.0323	-.165*	-.0919	-.0698	-.0517	1
Age	.0560	.0974	-.0279	-.00305	.0282	.0103
1st Generation	-.0310	-.365***	.425***	-.0877*	-.0408	-8.30e-08
Low SES	-.0793*	-.296***	.263***	-.0855*	-.00186	.0214
Chinese Language	.0406	.400***	.0402	.0124	-.100**	-.0656
English Language	.0265	-.380***	-.0980*	.188***	.104**	-.0837
Spanish Language	.0361	.000	.0945*	.00756	-.102**	.000
Multiple Languages	-.00931	.000	-.00170	-.106**	-.0558	.000

* p<.05 ** p<.01 *** p<.001"

Table C1 Correlation matrix (continued)

	Age	1st Gen	Low SES	Chinese Language	English Language	Spanish Language	Multiple Languages
Age	1						
1st Generation	-.0842*	1					
Low SES	.0341	.437***	1				
Chinese Language	-.00343	.0241	-.0328	1			
English Language	-.0931*	-.286***	-.298***	-.298***	1		
Spanish Language	-.00857	.0534	-.0112	.997***	-.386***	1	
Multiple Languages	-.0702	-.0748	-.0696	.0315	.344***	.0388	1

* p<.05 ** p<.01 *** p<.001"

Appendix D: TA Interview Protocol

International Students

Tell me what you have noticed about the international students – what has your experience been with them?

Do you think their participation differs?

To what extent do you think their facility with language influences their participation?

How does their presence influence the class?

Are there any aspects of your class or the lecture that particularly help or hurt them?

How many have come to office hours? What can you tell me about that?

Class activities

I've noticed that you (have the students mix into new groups every week). Can you tell me what your reasoning is for that? How does that impact the international students?

Individual then group quizzes

(Open questions and y/n (limited choice) questions)

(No cold calls)

(Raise your hand if…)

Reliance on group work vs individual/pair work

Names (know them all or not)

Did you notice any feedback on midterm evals that may have come from international students?

Lectures

How do international students respond to active learning techniques? Do you think they benefit in the same way other students would?

I notice that you go up and down the aisles during lectures – what are you looking for? Do you happen to notice anything about the international students?

For discussion sections, would it be better to have the international students all in one section, or is it better to have them mixed in across sections as they are now?

Can you tell me about your prior teaching experience?

Appendix E: Sample Codes, Descriptions, and Examples

Table E1 Descriptions and examples of material coded for benefits of peer instruction.

Code	Description	Example
Contact	Positive contact with classmates	"…just can have more contact with others. And it's very good."
Experience	Interaction, thinking, and re-thinking that will be of value for ISs' development as scholars and professionals	"University is like epitome of society, so like we would also, when we, like, leave university and start our first career, we would also need to interact with people. And this is what he is preparing us for."
Focus	Increased attention to class	"…it can help me to focus on the lecture."
Speaking skill	Improved speaking skill	"…when I talk to a foreigner I have to speak English and actually it can help me to improve my speaking as well yeah"
Learning	Umbrella for interaction that leads to increased understanding	
-About Q	Increased understanding of the question	"I get more information about the question"
-Gen. content	Increased comprehension of course content in general	"I think they also study hard on the material so I think I also learned a lot from them"
-Right answer	Emphasis on getting the correct answer, without necessarily expressing appreciation for content learning gains	"…you could be wrong in the first time and after the discussion you figure out what is the right one and you can just put the right one the second time"

Note: All sample codes in the table are nested under the parent code "Benefits," which is itself nested under the holistic codes "Active learning: Peer interaction." Code names preceded by "-" are nested within the parent code "Learning."