Evaluation of the Consortium for Education in Many-Body Application (CEMBA)

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# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Section Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Summary</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Introduction</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Demographics</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>Students Perceptions</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The Lab Space</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>The Course</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Other Suggestions</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Future Directions in CEMBA Evaluation</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>Conclusion</td>
<td>19</td>
</tr>
<tr>
<td>6</td>
<td>Appendix</td>
<td>20</td>
</tr>
</tbody>
</table>
1. Executive Summary

This report summarizes the data collected during spring and summer of 2001 regarding the National Science Foundation’s Integrative Graduate Education and Research Traineeship (IGERT) program at Penn State, the Consortium for Education in Many-Body Application (CEMBA). CEMBA, designed to foster interdisciplinary communication between various scientific fields, included a course introducing different many body applications and shared lab space for the graduate students. This data was collected through interviews and surveys to the nine participating CEMBA students. Due to the small sample size, most data collected is qualitative in nature.

The following are examples of conclusions drawn from the data:

**CEMBA Lab Facilities:** At the time of the interview, few students were utilizing the lab facilities in the George Building. Those that were participating tended to be at the beginning of their graduate careers. These students were disappointed that others had not utilized the lab facilities. Reasons that some students did not utilize the facilities included distance to their department and advisor, an already established office elsewhere, and lack of computer capabilities in the George office. Suggestions for improvement included having the faculty frequent the office to provide guidance and to have a presence.

**CEMBA Course:** Most students who participated in the course stated they had learned a lot about the different disciplines covered in the course. However, the students expressed concern about the lack of integration, the level of difficulty, and general disorganization of the course. Individual evaluations for each professor show that the students seemed satisfied with the lessons of most professors. Suggestions for improvement included more communication among professors to reduce repetition of concepts, to make the homework assignments at a consistent difficulty level, and to illustrate linkages in the material from week to week.

**Other suggestions:** All of the students expressed concern that they were not sure exactly what CEMBA entailed. Most felt that there was not enough information provided for them. Student suggestions included a meeting for all involved students and faculty to meet everyone and to establish policies for the project.
Many students also expressed interest in participating in seminars where they could make presentations on their on-going research. Also suggested were seminars ran by individuals from industry working in interdisciplinary areas to illustrate the applications of the material in a job setting.

Because the project is still in its beginnings, most data collected emphasizes how to improve the project. The project is in too much of an early stage to state whether the program’s aims are being met. As the program progresses and all components of the grant are implemented, more research will be conducted on whether interdisciplinary research has increased as a result of CEMBA.
2. Introduction

In Fall, 2000, Penn State University was offered a grant by the National Science Foundation (NSF) to fund an Integrative Graduate Education and Research Traineeship (IGERT) for the study of many-body problems in science. The Consortium for Education in Many-Body Application (CEMBA) focuses on the idea that the methods for studying many-body problems often overlap among the different sciences, although these problems may be on extremely different scales. The program is designed to encourage graduate students and faculty in chemistry, physics, materials science, mathematics, computer science and engineering to work together in studying these many-body problems. The program hopes to uncover new and interesting research questions that would never have been asked unless these individuals with different backgrounds worked together.

The goals of the CEMBA program are as follows:

1. To provide students with the necessary skills in the use of high performance and massively parallel computers with a wide range of algorithms and with exposure to a variety of problems.

2. To create scientists and engineers with breadth.

3. To foster communication between research in engineering and the sciences.

The components of the program, as indicated by the grant proposal, include a course, research projects, summer internships, a new seminar series, and tutorials. The interdisciplinary course is team taught by 9 professors each demonstrating a different application of many-body studies, which is designed to foster teamwork and collaboration among individuals from different fields. The graduate students, who are provided with assistantships from the program’s funding, have a laboratory space designed to encourage further collaboration and discussion of research among the various departments.

One of the most important aspects of any educational endeavor is assessment of the effectiveness of the program. Using measurable
devices, this assessment plan hopes to find whether the program is indeed effective at reaching the above goals. This document describes the questions that are being asked in order to analyze effectiveness of the program:

1. **Is CEMBA successful at recruiting and retaining students?**

   One indication of a program’s success is its ability to both recruit and keep its students. In particular, NSF encourages its funded programs to actively recruit women and minority students into scientific programs. The assessment will evaluate which methods of recruitment are most effective. Also, information about retention of students will be obtained.

2. **Is CEMBA creating scientists of breadth?**

   The major focus of CEMBA is to create individuals with understanding of problems not only within one particular field, but across the sciences. Do these students better understand of these problems across the sciences? Are new questions and answers regarding many-body problems being found across the sciences? Are these students more likely to enter interdisciplinary careers?

3. **Are CEMBA students more proficient in parallel computing?**

   Are these students receiving training in powerful computers that they would not get outside of this program?

4. **Does CEMBA foster teamwork and collaboration?**

   Are both faculty and graduate students more likely to work with individuals outside of their home department?

5. **How does CEMBA affect the attitude and motivation of graduate students?**

   What is the student attitude towards interdisciplinary research? Ideally, working collaboratively should increase amount of perceived support and increase student motivation. Students may feel that they have more research and career options open to them due to the interdisciplinary nature of their training. Do CEMBA students have a better attitude than non-CEMBA students?
At this stage in the evaluation, the information that can be collected in the program is rather limited as the project is still being formed. Therefore, most information collected on the students has focused on improvement of the components of the projects that have been implemented already. Specifically, most information has revolved around the lab space in the George Building and the introductory course. Information on demographics has been collected to gain an understanding of the characteristics of the CEMBA students. Also, information on the students’ wants and desires for the CEMBA program has been collected.

As the program progresses and more components are instituted from the original grant proposal, more meaningful information on whether the program is actually working can be collected.

### 3. Demographics

An important question to consider in the CEMBA program is the characteristics of the students we are recruiting. In order to garner important background information, a demographic survey was administered to all CEMBA students asking questions such as gender, race, undergraduate school, current year in graduate training and other degrees held.

In the CEMBA program, of the nine students, two are female and seven are male. One student is Asian and the remaining students are of Caucasian decent. Two students are pursuing degrees in aerospace, three in physics, and one each in chemical engineering, IGPM, and computer science. Four students had just begun their graduate career in 2000, one in 1998, and three in 1997. Schools of undergraduate education include Penn State, University of Illinois at Urbana-Champaign?, Boston University, Clemson University, and schools abroad in Taiwan and Russia. Three students already hold masters degrees in the sciences. One student already has a PhD.

When asked their reasons for entering the CEMBA program, eight of the students included funding as the most important force. One student’s primary reason for entering the program was the emphasis on interdisciplinary training. All students had heard about the CEMBA program through their advisor.
4. Student Perceptions

This section of the report includes student perceptions of the program thus far. Methods of collecting this information included interviews and surveys. Students were also asked to e-mail the evaluator if they had any problems or suggestions at any time during the year. All the comments below are anonymous. Any identifying information such as department has been removed.

A. The Lab Space

Part of the initial grant proposal was to institute a common laboratory space complete with powerful computers in which students can work and intermingle with their fellow CEMBA students. The idea of this lab space was to foster communication and promote interdisciplinary research among the CEMBA students.

Based on the interview data, the students appeared to have mixed feelings about this lab space. As of the March interview, only two students admitted to using the lab space on a regular basis. The reasons the other students did not utilize the lab space to its fullest potential include distance to their department and their advisors, an already established lab space elsewhere, and lack of computers. The interviews were taken in March prior to the lab being fully equipped.

The following quotations are taken from the interview data regarding reasons the lab has not been used by some students:

- The thing that’s difficult for me is a lot of people have their offices in this area or they work out of this area. But [my department’s] building is on the other side of campus so it’s like 10 minutes back and forth. And my advisor is there.

- I didn’t use it very much because I’m mostly using computer and my office has a computer.

- I like my office now. [The George Building is] farther from the department, the library, and my advisor – things like that.

- At this point because of where I am in my research I do most of my work at home. I have an office set up at home with a couple computers. So I’m usually spending most of my time at home. If I come to campus it’s because I am meeting with my advisor or other students. I do have an office in [my] department, but I don’t spend much time there either.
• It seems to be all . . . people [from a certain department]. They sort of moved in
there. I already have another office so I use that for the most part. I go in there
and the place is already taken over. Like I said, the only reason that I’d have to
go in there is the computer because right now I do all of my work in the
computer lab.

• The biggest problem, from talking to the other students, is that it’s too far from
where they need to be . . . I don’t know if that’s really a valid excuse or not.
That’s what they say that it’s too far.

Students who had moved completely into the office at that point in time
were disappointed that others hadn’t seemed interested. Here are some of
their comments.

• The only expectation I had is that I would assume that more people would be
active. There’s no benefit to having people spread out all over campus working
on the projects. I just expected to have more people in the office.

• If there are people that I’m involved with projects with and they are also
hanging out in that office then I would go in and do my work there. It’s nice to
have other people around on my projects to talk to.

• I know that the reason that I’m in the program is just that I like the particular
project that I’m working on but as far as the whole interdisciplinary research
thing, I suppose I haven’t been exposed to that much of it yet. Like I said,
there’s only one other person who comes to the office regularly and he’s in my
department so I’m not really sure how much other professors are encouraging
their students to get down there and move in and be part of the group. I know
my advisor is very big on it, he’s like hey you’ve got to move down there as
quickly as possible. I want everyone in there. So, yeah, the other guy down
there, he has the same advisor as me so I’m sure that’s a big part of why he’s
down there, too.

• But [CEMBA students] don’t even come to the office so it’s hard to distinguish
in the class who’s just taking the class and who’s a CEMBA member. And I
know some of the people in the program aren’t taking the class.

Some students complained about the lack of contact with the CEMBA
faculty at the George building:

• I just think they need to be seen. But even my advisor, he doesn’t really ever go
to the office. It’s kind of frustrating that I know there’s six other people, six
other advisors but I never see any of them.

• I think that some of the professors really aren’t as interested in the program as
some of the other professors. I mean you can definitely tell whose students have
moved into the office, who’s been around. Professors don’t come down there
too often, but I mean, there are a few who have definitely shown their faces once
or twice.
• [The CEMBA project would be improved] If the instructors, the faculty involved in CEMBA have an office space in CEMBA... otherwise it’s going to be hard to contact them.

Some other suggestions from the students for more participation in utilizing the lab are shown in the following comments:

• I think if you tell them when you come in, here’s your office, that’s where they’re going to go but if someone’s had an office for three years or something like that they’re not necessarily going to want to move. At first I didn’t want to move either because it’s helpful to be near other students [from my department] for my other classes so I can talk to them about homework and that kind of stuff.

• I would [use the lab more]... if they put in computers and they’re on the network...

B. The Course

Not all nine CEMBA students enrolled in the “Introduction to Many-Body Applications” course. The ones who did enroll were more towards the start of their graduate career. A couple students who were farther along came to the course occasionally. Some non-CEMBA students also enrolled in the course.

CEMBA students were asked during their interviews to generally state how the course was going and if they had any suggestions for improvements. All students enrolled in the course were administered a checklist survey and an open-ended questionnaire mid-semester to rate how the course was going thus far. Appendix I contains the results for all the questions in the mid-semester checklist which was completed by seven students. Some quotations from the open-ended questionnaire and the interview are displayed below. If you wish to see the results of the open-ended questionnaire in its entirety, please ask the evaluator. At the end of the semester, students were asked to fill out a questionnaire on each professor who taught the course. The individual feedback forms will be distributed to each professor separately.

For the most part, students agreed that the course was progressing well, albeit some rocky points. The information in the checklist survey, for the most part, is positive in nature. Students agreed that they were learning a lot about the different disciplines and that they could form connections between the material. Many students enjoyed the variety of topics covered in the course. The following quotations from the open-ended questionnaire highlight the positive comments students made about the course:

• I have received a solid introduction to several topics that I use in my research.
• When presented clearly, the material has been novel and interesting. I’ve
learned new ways to solve old problems.

• The mix of topics has been interesting and many of the assignments exposed me
to interesting methods in different fields.

• [Having multiple instructors] gives different perspective to look at things

• I knew other people used the same kind of techniques that we use in simulating
chemical engineering processes but I had no idea [how helpful the information
would be].

• I think it’s an interesting course, particularly the tag-team teaching approach
gives a good broad background and gives people an idea of what other
disciplines are about.

• [The course is going] pretty good because those instructors have their expertise
in their research. They already have a lot of experience in dealing with their
research topic. They really have a lot of experience.

However, all students agreed that the course could use improvements in
several areas. Several themes of difficulties or suggestions for
improvement repeatedly emerged in this survey as well as in interview
data. The following information highlights these themes utilizing students
quotations from the survey, the open-ended questionnaire and the
checklist.

Integration of content: Many students complained about the lack of
integration of content from week to week. Although the objective of the
course is to introduce students to various themes in the course, students
often found the lack of integration and consistency from week to week
frustrating and difficult. In the checklist survey, five students said that the
professors seemed to just take turns teaching rather than integrating the
content from week to week. Many students thought that the post-doctoral
student would be more efficient at integrating the material. Six students
agreed with feeling frustrated at having multiple instructors.

When asked what students liked least about the course and suggestions for
improvement, some students expressed the following about the course:

• Lack of continuity and coordination between consecutive instructors

• Not much connection between what professors teach

• The instructors were not well-organized, mainly it seemed, because their
attention span was limited to the weeks that they were scheduled to teach
(generally speaking).
• Getting a look at the variety of disciplines that share common techniques is an attractive goal. But, the lack of integration, and in some cases, dedication, was frustrating at times.

• The material flows well from week to week but the professors don’t know what has or hasn’t been previously covered.

• One professor should at least try to link what others have talked about.

• If their material uses ideas presented by another instructor, make specific references.

Some quotations from the interviews show the students’ concern about the integration of the material:

• I think, which is probably a direct relationship with it being new, but I think it’s very scatter-brained. Like there’s no order to it. In my opinion, there’s no order to it. It’s just like okay, we’ll talk about this, and the next time, oh, we’re going to talk about this. It doesn’t seem like it’s flowing.

• I just don’t think that there’s that much communication between the instructors. It’s like, well, let’s do this, oh I think somebody else talked about that. I don’t know. Did they say this? . . . There doesn’t seem like there’s a general plan. It’s just like, here’s your week, talk about what you want. And then we’ll go to the next guy the next week and let them talk about what they want.

• I don’t have any particular problems but with a seminar being like that things tend to be a little scattered, but I guess that was pretty much expected going in because there are 8, 10, 12 different professors teaching it.

• Students suggested that the professors meet more often and attempt to integrate the material slightly more in order to increase their understanding.

In general, most students thought that if professors met more often, the course would flow better and their learning would increase.

Coping with different styles: Many students found it difficult to adjust from week to week as the different instructors had different teaching styles. The students found great differences in the level the homework demanded from week to week. Due to the continual changing style in teaching, the students found the class to be more challenging than most. Here are some of their quotes from interviews and the open-ended questionnaire:

• It is somewhat difficult because you have to adapt to a new teaching style and a new type of homework each week.

• It’s hard because there’s a different professor every week and they all have their own style. They don’t know what’s been taught yet. And so if they maybe discussed and tried to come up with a general plan on how they would handle things and who would teach what areas.
• Try to standardize the difficulty level of the homework, because the expectations of some professors have been much more than others.

• Homework assignments have greatly varying levels of difficulty and expectations.

Although the different styles of teaching seemed to be a source of frustration, most students seemed to cope with it well. However, students suggested that more communication be made among instructors so that levels of difficulty in homework be made more consistent and to reduce repetition in covered content among professors.

Level of difficulty. Many students complained about the level of difficulty of the course. The first-year graduate students in CEMBA often complained about their lack of exposure to the material covered by professors outside of their department, as is shown by their quotes below:

• And sometimes, a lot of times, if it’s a professor from a different department, they expect that you have a certain level of knowledge, and for me, since I’m not physics or chemistry, I have no idea what they are talking about.

• Sometimes it’s too high level and you just learn what you need to do to finish the homework.

• And that’s part of the problem why they assume a certain level of knowledge because they don’t have time to teach you the basics.

• Professors don’t always realize that some students don’t have an introduction to the material they’re covering and go too in depth without first giving a good introduction. This is partly due to time constraints.

• Some instructors assume prior knowledge / ability that is not generally expected.

• Help them know what we know and what we don’t know.

• With the exception of the two weeks that my advisor taught, I’ve really been so lost in this class because I don’t have the background.

Students who were farther along in their graduate career often had the exact opposite reaction:

• That was the other thing I did see from the classes I did go to that since I have a background in engineering, that seems to be the place where a lot of CEMBA faculty were coming from what they were talking about was not necessarily new to me. And with ten years involved with mechanics work and aerospace, it’s nothing new.

• Some instructors are teaching at a slow pace.

A suggestion for improvement is to understand the different levels the students are at prior to each professor’s lecture. This way the professor will know at what level they need to teach in order to maximize learning
for the majority of the students. For those students who may have less exposure to the material in a particular week, extra help sessions may ease frustration and difficulty.

*Breadth, not depth:* Many students were disappointed about the lack of depth that the course allowed. Again, although the course is designed to offer a brief introduction into various applications of many-body problems, some felt that they lacked information on the basics. For the most part, students wished they were able to get more in depth with each week’s materials. Unfortunately, this problem is mostly due to the lack of time allotted to each professor. Here are some of the students comments on this topic:

- Less time to understand the homework more deeply.
- Professors don’t always realize that some students don’t have an introduction to the material they’re covering and go too in depth without first giving a good introduction. This is partly due to time constraints.
- Probably each professor needs one more week to have more detailed instruction.
- Actually, really sometimes [the professors have] only two days [to teach] if they want to do a lab. It’s really hard to get everything in in two days. And that’s part of the problem why they assume a certain level of knowledge because they don’t have time to teach you the basics.
- It’s kind of hard because we get such a small taste of everything. . .
- [The course would be better] If we can offer them one more week. Not so many fields of interdisciplinary area – not so many instructors. . . [A good idea would be to] provide two semesters. CEMBA 1 and CEMBA 2.

Because of the time constraints posed by the grant proposal, the problem posed above is difficult to remedy. Although several students suggested having the course meet more often (such as during the course of two semesters), this suggestion may be unfeasible. However, frequent meetings with the professors may increase organization and thus make the time spent in class more efficient. Also, knowing the level of the students a priori may allow for the information taught in class to be better understood and again, make the class time more efficient.

*Course specifics:* Many of the comments received by students concerned specifics of this year’s course, including the class website and overall course organization.

Some students commented that the course needed better organization. As shown in their comments below, often time miscommunication and disorganization lead to frustration:
• The professors should pay attention and adhere to the formats for class times, locations, homeworks, etc. It would be helpful to them, I think, to attend class, perhaps for at least the most closely related topics that precede their own lectures.

• The instructors were not well-organized, mainly it seemed, because their attention span was limited to the weeks that they were scheduled to teach (generally speaking).

• [One professor] did not appear to prepare in advance by [becoming familiar] with the course policies, schedules, and previously taught materials.

• [One professor] didn’t show up for lab sessions.

• And with the class, you can tell, who just pulled something out of the files from ten years and said, I’ll show this because I have to teach something this week and who actually put some thought into it.

Suggestions to avoid disorganization is more communication through meetings and e-mail notices to instruct the professors on on-going course policies.

In the open-ended questionnaire, several students complained about the course website:

• Put the course notes on the web, as had been planned, so that professors can see what has been covered.

• Post on the web the notes ahead of time so that they can coordinate their lectures (avoid repetition), also help them know what we know and what we don’t know.

• Post notes on the web. If their material uses ideas presented by another instructor, make specific references.

• The professors didn’t seem to do anything with the website. It was all Tom.

Most students liked the idea of the website, but were disappointed on how it was carried out. A suggestion for improvement would be to have the professors submit material for posting ahead of time, rather than after their week’s lecture.

Summary:

Overall students enjoyed the course. However, they were a bit frustrated with the lack of integration, the lack of content depth, the overall course difficulty, general disorganization, and the course website. Suggestions for improvement include more frequent meetings to encourage consistency among professors, assessing background knowledge of material before teaching class, increased class time, and more frequent and up-to-date website postings.
C. Other Suggestions

CEMBA students had a lot of ideas and suggestions for the program. These suggestions include holding more meetings, seminars, and presentations. Students emphasized that they wished to feel better informed about what CEMBA is and what they should expect. The information highlighted below was obtained through the student interviews.

Feeling in the dark: First and foremost, CEMBA students felt they lacked information about the program. Many students had no idea what CEMBA entailed or if they had any requirements. They simply felt they were told they would be funded by the program yet had no concept of what CEMBA was all about. Not one student was aware of a second advisor requirement. All students acknowledged they did not know if they had any responsibilities being a CEMBA student. Here are some of their quotations on the subject:

• [My advisor] really didn’t explain to me what it was.

• I really had no idea what was involved with the program. My advisor said, I have grant money for this, you get an office in George building with your own computer, sounds fantastic but I had no idea what was involved or what’s going on.

• I think by this point, we’ve been here 8 months, there should have at least been some sort of meeting with everybody or just at some point to meet these other people that theoretically I’m working with.

• Obviously a place to start is to let us know what the program is all about, what the requirements are, what the goals are, what is expected.

• I think the only thing I would like to know at that time is there any goals for CEMBA? Usually when we enter a project, usually the project has very specific goals. Like what task we need to achieve. What result we need to get.

• I’d like to make sure that I have the information that I’m supposed to know about. I would like to know what my requirements are in writing. For example, I got this e-mail that I had to fill out a web survey. I didn’t know that I was required to fill out a web survey. Not that it was a problem.
• Am I supposed to have any obligations? I haven’t been given anything written.

Every student expressed frustration at not quite knowing what the CEMAB program entailed. A suggestion to alleviate their concerns may be to hold a meeting between all involved faculty and students. A written document explaining CEMBA and the students obligations may also help.

More involvement: Many students suggested that there were other methods of becoming involved in the program. Several suggested that seminars be held and a few even offered to present at these. Here are some comments:

• I thought I should participate in some seminars and make presentations but I didn’t get any information. I tried to find out but I couldn’t find any information. I think seminars are a good way to facilitate interaction and exchange of ideas in presentations.

• Seminars would be very helpful. More interaction between students especially if there are many students who do interdisciplinary research. It’s very hard to find people to discuss your results. . .

• [A good idea would be] if they had a seminar series and had individuals come in and say I work at this company and this is what I do. . .If there were something like that, in a sort of seminar series, where they could talk about, . . . what they’re doing, but something like that where you would have this group of individuals and they would discuss their current research and how everybody’s piece of the pie is fitting together would probably be interesting too and help interdisciplinary communication.

• Like a seminar probably [would improve CEMBA]

• Or if there could be things like talks. In [my] department, we have colloquia every week. . . For example, if I went for a talk that someone was giving in some of these other disciplines, that would foster my interest.

• Yes, I just mean generally if we had an e-mail that went out that said there’s a talk. You can go if you want to. You don’t have to go. Just being informed on what’s going on.

• For people who have research, it might be a good idea if we gave presentations of what our research was. So instead of just
understanding what the professors in another department do, we can understand what it’s like to be a grad student in another department.

- Or some sort of student organization so that they can gradually meet each other about their research.

5. Future Directions in CEMBA Evaluation

As discussed above, once all the components of CEMBA are instituted, the focus of the evaluation will change. Although the perceptions of the students on how to improve the program will still be collected, most data collected will reflect whether the program is indeed working or not.

This upcoming semester, entrance interviews will once again be conducted for any new students that enter the program. The purpose of this interview will be to collect any necessary background information as well as asking about the students’ hopes for the program. Students who are in the CEMBA program for the second year will either be interviewed or be asked to fill out surveys to assess their opinion of the program so far.

For the course in the spring, a mid-semester and final semester evaluation consisting of a survey and open-ended questionnaire will once again be administered. However, instead of administering individual professor’s evaluation at the end of the semester, a once a week survey, probably administered via e-mail, will be given. This method of administration will increase the amount of meaningful feedback given that the week each professor teaches will be more recent in the students’ minds.

In addition to the above data collection procedures, the following lists methods that will be undertaken during the next several years to answer the questions listed in Section 1 of this document:

1. Is CEMBA successful at recruiting and retaining students?

   a. Recruitment: The grant proposal identifies several methods of recruitment including mass mailings, meetings with undergraduates, open houses and the NSF Research Experiences for Undergraduates (REU) program. Students will be asked where they heard of the program in the initial questionnaire which will be given as soon as possible after CEMBA students begin their graduate career (Spring for CEMBA 2000 cohort). If
students identify more than one source of information, they will be asked which persuaded them most to enter the program. Information on why each method is successful may be obtained through each student’s entrance interview.

b. Retention: Information on retention will be gathered throughout the evaluation and compared to retention of non-CEMBA students and of students in previous years. Students who drop out of the program will be required to participate in an exit interview to gather reasons for leaving the program/Penn State.

2. Is CEMBA creating scientists of breadth?

Research and understanding:

a. Analysis of Course

Qualitative information will be collected from the team taught course. Care will be taken to pinpoint any problems or barriers that may occur with many individuals teaching the course. Any problems that do occur will be reported anonymously to involved faculty so that the benefits of the course may be maximized and problems can be minimized in future years. Data will be collected through the use of surveys and focus groups. Both CEMBA and non-CEMBA students will be asked to participate in this portion of data collection, since the course is open to all students.

b. Analysis of student research

In order to analyze the level of interdisciplinary research occurring in the program, students will be asked to submit their curriculum vita on an annual basis. This will provide information regarding publications, conferences, and accomplishments by the students. This information will be compared to that of volunteer non-CEMBA students in order to see if there is more interdisciplinary research occurring in the CEMBA program. Although this information gathering will begin in Spring 2000, the bulk of the information will be gathered during the 3rd and 4th year of the student’s graduate career.

Students will also fill out a qualitative survey annually in order to collect information on their thesis proposals or other research projects that may be interdisciplinary.

d. Grades/Transcripts

Grades for CEMBA students will be compared to the volunteer non-CEMBA graduate students in order to compare academic performance.
This will ideally begin in spring, 2000. This information will be collected through the office of the registrar. Also, the students’ transcripts will be used in order to

**Careers:**

Information about whether CEMBA is creating scientists of depth can also be obtained by analyzing the types of careers these graduate students choose. This information can be obtained through the following sources:

a. Exit Interview

Each graduate student will be asked of their career path during a required exit interview upon the completion of their graduate work. Students will be asked to state where they have taken a position and the nature of that work. They will also be asked about their perceptions of opportunities available to them after completion of the CEMBA project. Other questions would include what factors contributed to their perceptions of job opportunities (i.e. conferences, faculty, team participation, etc.) and how CEMBA may have had any influence. Similar data will be collected from the control group. This data collection will not start until the end of the first year cohort’s program.

3. Are CEMBA students more proficient in parallel computing?

Students will be asked about their perceived proficiency in parallel computing during interviews and focus groups. They will be asked if they were able to gain experience using equipment that they might not have otherwise been able to use. Similar questions will be asked to the non-CEMBA students.

4. Does CEMBA foster teamwork and collaboration?

Student research initiatives involving faculty and students from different departments will be analyzed through the collection of the curriculum vitas. Also, through survey information, students and faculty will be asked whether they are currently working on any research projects with people outside of their department. The survey data will also attempt to measure the attitude toward interdisciplinary inquiry and collaboration. This data collection, which will be compared to that of non-CEMBA individuals, will start immediately and continue throughout the program.

5. How does CEMBA affect the attitude and motivation of graduate students?
Information regarding attitude and motivation will be collected via surveys and questionnaires.

Non-CEMBA control group

As discussed above, a control group is necessary in order to most effectively analyze of the program. At this point in time, utilizing a control group is unnecessary as the program is still being developed. However, as the program progresses, a control group will be vital to answering many of the above questions. If a control group can be feasibly found that are relatively similar to CEMBA students, then more meaningful research can result.

6. Conclusion

Penn State University’s CEMBA program offers students a wonderful opportunity for interdisciplinary research. Although the program is still being developed, most students seem relatively happy with the results thus far. In future years of the CEMBA program, improvements should be made to allow for more participation among students and faculty by enhancing communication through such methods as meetings and seminars. The goal of the evaluation in the next several years is to begin focus on whether the CEMBA program is indeed encouraging and establishing research groups investigating interdisciplinary principles and concepts.
Results of mid-semester checklist for “Introduction to Many-body Problems” course:

Below are the results of the quantitative survey along with any comments for each particular item. The questions below are organized by theme for ease of interpretation. Students were administered a randomized version of the survey. Students ranked each item in a scale ranging from strongly agree to strongly agree. The number next to each rank corresponds to the number of students who chose it. The number in parentheses corresponds to the class percentage of students who chose the statement. Comments are written in italics below each item.

Overall View of Course

1. Having multiple instructors has been a positive experience for me.
   - Strongly Agree – 0 (0%)
   - Agree – 4 (57%)
   - Neutral – 1 (14%)
   - Disagree – 2 (29%)
   - Strongly Disagree – 0 (0%)

2. The learning environment is improved by having multiple instructors.
   - Strongly Agree – 0
   - Agree – 3 (43%)
   - Neutral – 3 (43%)
   - Disagree – 1 (14%)
   - Strongly Disagree – 0

3. Having multiple instructors is more challenging to me than single instructor courses.
   - Strongly Agree – 1 (14%)
   - Agree – 6 (86%)
   - Neutral – 0
   - Disagree – 0
   - Strongly Disagree – 0

   • Each professor has their own style.

4. Having multiple instructors has enhanced my interest in the material.
   - Strongly Agree – 0
   - Agree – 5 (71%)
   - Neutral – 1 (14%)
   - Disagree – 1 (14%)
   - Strongly Disagree – 0

5. The course encouraged me to analyze issues with more confidence.
   - Strongly Agree – 0
   - Agree – 2 (29%)
   - Neutral – 4 (47%)
   - Disagree – 1 (14%)
   - Strongly Disagree – 0

6. This course encouraged me to think for myself with more confidence.
   - Strongly Agree – 0
   - Agree – 1 (14%)
   - Neutral – 6 (86%)
   - Disagree – 0
   - Strongly Disagree – 0

Course specifics

1. Information learned in the lab sessions has been positive for me.
   - Strongly Agree – 1 (14%)
   - Agree – 0
   - Neutral – 4 (57%)
   - Disagree – 0
   - Strongly Disagree – 2 (29%)
• I think the labs should be replaced by lectures, although the homework themselves were fine.

2. I feel more competent in the use of parallel computing
   Strongly Agree – 0
   Agree – 3 (43%)
   Neutral – 0
   Disagree – 1 (14%)
   Strongly Disagree – 3 (43%)

• Never used.

3. The course web site is updated quickly enough.
   Strongly Agree – 0
   Agree – 2 (29%)
   Neutral – 2 (29%)
   Disagree – 3 (43%)
   Strongly Disagree – 0

• My impression was that the teaching professors did not contribute to it at all.

4. The course web site is helpful in understanding the material.
   Strongly Agree – 0
   Agree – 2 (29%)
   Neutral – 0
   Disagree – 4 (57%)
   Strongly Disagree – 1 (14%)

• Instructors’ notes are seldom posted.

5. The weekly homework assignments help me to better understand the material.
   Strongly Agree – 1 (14%)
   Agree – 4 (57%)
   Neutral – 1 (14%)
   Disagree – 1 (14%)
   Strongly Disagree – 0

• Sometimes the homework is too advanced unless you are from the same department as the professor.

Possible problems

1. Having more than one instructor is confusing.
   Strongly Agree – 0
   Agree – 2 (29%)
   Neutral – 3 (43%)
   Disagree – 2 (29%)
   Strongly Disagree – 0

2. I am not sure who to go to with questions about course content.
   Strongly Agree – 0
   Agree – 1 (14%)
   Neutral – 0
   Disagree – 6 (86%)
   Strongly Disagree – 0

• Tom seems to be able to answer most questions, or to find out, if he doesn’t know.

3. I feel I receive conflicting information from the different instructors.
   Strongly Agree – 0
   Agree – 0
   Neutral – 0
   Disagree – 6 (86%)
   Strongly Disagree – 1 (14%)

4. I often feel that the instructors have different standards and objectives.
   Strongly Agree – 3 (43%)
   Agree – 3 (43%)
   Neutral – 0
   Disagree – 1 (14%)
   Strongly Disagree – 0
• **Professor’s don’t realize that students have different backgrounds.**

5. **I am frustrated with having different instructors.**
   - Strongly Agree – 1 (14%)
   - Agree – 5 (71%)
   - Neutral – 0
   - Disagree – 1 (14%)
   - Strongly Disagree – 0

• **Sometimes it is difficult because each professor has different expectations and most don’t realize that everybody has a different background since we’re all from different departments.**

6. **Studying these topics together made them more difficult to understand.**
   - Strongly Agree – 0
   - Agree – 0
   - Neutral – 1 (14%)
   - Disagree – 6 (86%)
   - Strongly Disagree – 0

7. **Having more than one instructor is uncomfortable for me.**
   - Strongly Agree – 0
   - Agree – 0
   - Neutral – 3 (43%)
   - Disagree – 4 (57%)
   - Strongly Disagree – 0

Integration of content

1. **The material taught by each instructor helps clarify the material taught by another instructor.**
   - Strongly Agree – 0
   - Agree – 1 (17%)
   - Neutral – 1 (17%)
   - Disagree – 4 (67%)
   - Strongly Disagree – 0
   - Blank – 1

2. **Being presented with different views helps me to understand the overall subject better.**
   - Strongly Agree – 1 (14%)
   - Agree – 3 (43%)
   - Neutral – 3 (43%)
   - Disagree – 0
   - Strongly Disagree – 0

3. **The interdisciplinary nature of the course helped me understand the issues covered in the course more deeply.**
   - Strongly Agree – 1 (14%)
   - Agree – 3 (43%)
   - Neutral – 1 (14%)
   - Disagree – 2 (29%)
   - Strongly Disagree – 0

• **Professors don’t have enough time (1 week) to get in depth.**

4. **Having more than one instructor enabled us to explore the topics discussed more deeply.**
   - Strongly Agree – 0
   - Agree – 2 (29%)
   - Neutral – 1 (14%)
   - Disagree – 2 (29%)
   - Strongly Disagree – 2 (29%)

5. **Having Tom (the post-doc) in the classroom helped us to integrate the concepts taught by the different instructors.**
   - Strongly Agree – 0
   - Agree – 2 (29%)
   - Neutral – 3 (43%)
   - Disagree – 2 (29%)
   - Strongly Disagree – 0

• **Although it should help to keep the professors organized and consistent [after responding with a disagree to the above statement]**

6. **I am able to form connections in the material presented by different instructors.**
7. I feel that the instructors simply take turns teaching without integrating the course content along the way.
   Strongly Agree – 1 (14%)
   Agree – 4 (57%)
   Neutral – 1 (14%)
   Disagree – 1 (14%)
   Strongly Disagree – 0

- Most professors don’t know what previous professors have taught.

Having students from other departments

1. Having students from departments other than my own has increased my understanding in the sciences.
   Strongly Agree – 1 (14%)
   Agree – 2 (29%)
   Neutral – 2 (29%)
   Disagree – 2 (29%)
   Strongly Disagree – 0

2. Students from other departments often contribute information to the class that enhances my understanding of the material.
   Strongly Agree – 1 (14%)
   Agree – 0
   Neutral – 1 (14%)
   Disagree – 4 (57%)
   Strongly Disagree – 1 (14%)

3. I am more comfortable in classes that have only students from my department
   Strongly Agree – 0
   Agree – 0
   Neutral – 1 (14%)
   Disagree – 6 (86%)
   Strongly Disagree – 0

4. I prefer to be in a class with students only from my own department
   Strongly Agree – 0
   Agree – 0
   Neutral – 1 (14%)
   Disagree – 5 (71%)
   Strongly Disagree – 1 (14%)