THE INTERNATIONAL JOURNAL of SCIENCE IN SOCIETY
COMMON GROUND

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The file is in Microsoft Word format. Each file commences with this letter, followed by the referee report and then the paper itself.

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Please don't hesitate to contact me by email if you have any questions about the refereeing process. I look forward to hearing from you.

Yours Sincerely,

Kathryn Otte
kathryn@commongroundpublishing.com

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Please observe carefully the following guidelines on the role of the referee.

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4. **Intellectual Merit:** A paper must be judged on its intellectual merits alone. Personal criticism or criticism based solely on the political or social views of the referee, is not acceptable.

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SUBMISSION GUIDELINES

Papers should be approximately 2,000-5,000 words in length. They should be written as continuous expository narrative in a chapter or article style - not as lists of points or a PowerPoint presentation.

The papers are to be published in a fully refereed academic journal. This means that the style and structure of the text should be relatively formal. For instance, the paper should not be a verbatim transcript of an oral presentation, such as 'Today I want to speak to you about ...'.

Authors may use any referencing style they choose, as long as it is used consistently and to the appropriate standards. Spelling can vary according to national useage, but should be internally consistent. Papers should be thoroughly checked and proof-read before submission, both by the author and a critical editorial friend.

Papers are assessed by referees against ten criteria - or fewer if some criteria do not apply to a particular kind of paper:

1. Significance of Themes
2. Relevance of Themes
3. Clarity of Thematic Focus
4. Relationship to Literature
5. Research Design and Data
6. Data Analysis and Use of Data
7. Use of Theory
8. Critical Qualities
9. Clarity of Conclusions
10. Quality of Communication

DIFFERENT KINDS OF FOCUS

Papers may have different kinds of focus which will require adjustment to the way the referee criteria are applied. For instance:

Practice Focus: A paper which describes innovative or exemplary practices or programs in the community, in workplaces, in education institutions and the like. This may take the form of case studies, narratives, demonstrations or technical reports. The outcomes of practice may be improved frameworks, concepts, understandings or structures, such as enhanced capacity through the development of skills, knowledge and operational effectiveness. This kind of work may involve putting theory and research into practice. *In this case, criteria 4, 5, 6 and 7 may not be relevant (in which case mark as not applicable or 'n.a.') and you should calculate an average score across the other criteria.*

Research Focus: A presentation or publication reporting upon original research, based on the systematic collection and analysis of data or facts. This kind of work may involve the application or testing of theory. *In this case, criterion 7 may not be relevant and an average score should be calculated across the other criteria.*

Theory Focus: A presentation or publication which is broad and generalising in its emphasis, reflecting upon and systematically referenced against one or more bodies of literature or systems of thought. *In this case, criteria 5 and 6 may not be relevant and an average score should be calculated across the other criteria.*

EDITORIAL QUALITY

The refereeing process for publication in the Journal is a rigorous measure of the quality of content. Authors are expected to revise to the standards required of the more negative of the referee reports they receive. For instance, if one referee recommends 'resubmit with major revisions' and another 'resubmit with minor revisions', the author is expected to resubmit with major revisions.

Furthermore, some papers may have excellent content, but may be poorly expressed in English - in the case, for instance, of authors whose first language is not English. When we receive a negative response from a referee to Criterion 10, 'Quality of Communication', we may request a complete rewrite regardless of the overall score. This could be arranged by the author themselves, preferably using an experienced editor. Alternatively, Common Ground offers an editorial service.

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REFEREE'S REPORT: SUMMARY SHEET

Score each item on a range from zero to 10. For detailed criteria for evaluating each item, see the COMMENTS section which commences on the next page. If your comments add up to a score of 75% or above and you have no further comments, it is sufficient to complete this page alone.

EVALUATION CRITERIA	SCORE
1. Significance of Themes	8
2. Relevance of Themes	8
3. Clarity of Thematic Focus	7
4. Relationship to Literature	5
5. Research Design and Data	5
6. Data Analysis and Use of Data	6
7. Use of Theory	7
8. Critical Qualities	7
9. Clarity of Conclusions	5
10. Quality of Communication	6
TOTAL SCORE % If some categories are not applicable in evaluating this particular paper, mark n.a. (not applicable) and calculate score as % average score across relevant items.	64

RECOMMENDATION

[ ] ACCEPT
[X] ACCEPT WITH MINOR REVISIONS
[ ] RESUBMIT WITH MAJOR REVISIONS
[ ] REJECT

The following are indicative score ranges:

- Accept (without qualification): 75-100%
- Accept with minor revisions: 60-75%
- Resubmit after major revisions: 40-60%

- Reject: Below 40%

REFEREE'S COMMENTS

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Guidelines for comment: The scoring table on the previous page has been designed for quick comment. You don't need to comment in this section unless:

- you have given a low score in any of the evaluation criteria; or
- you believe you need to justify having given the paper a high score on any of the evaluation criteria; or
- you have indicated that a response to any of the evaluation criteria would be 'not applicable' because the paper legitimately does not set out to be proficient in that particular area (for instance, pure theory or philosophical argumentation which does not use conventional 'data'); or
- you have specific advice or comments you would like to provide the author(s) in relation to any of the evaluation criteria.

If any of the above applies, and particularly if you have recommended rejection or revision, then please elaborate:

1. Significance of Themes

- Is this a topic that needs addressing? Is the area investigated by the paper: timely? important? in need of addressing because it has been neglected? intrinsically interesting? filling a gap in current knowledge? (The paper does not have to be all of these things to be significant; it is sufficient to measure it against one of these forms of significance.)
- By addressing these themes, does this paper make a useful contribution? Is it itself significant?

REFEREE COMMENTS:
Useful

2. Relevance of Themes

- Are these themes relevant to this publication? If not, is there a more appropriate place for publication?

REFEREE COMMENTS:
Relevant

3. Clarity of Thematic Focus

- Are the author's themes clearly stated?
- Does the paper follow through by addressing these themes, consistently and cogently?

REFEREE COMMENTS:
Adequate

4. Relationship to Literature

- Does the paper demonstrate an adequate understanding of the current literature in the field?
- Does it connect with the literature in a way which might be useful to the development of our understanding in the area it addresses?

REFEREE COMMENTS:
The review of relevant literature seems adequate, though even this needs some critical interrogation than has been done by the author (s)

5. Research Design and Data

- Has the research, or equivalent intellectual work upon which the paper is based, been well designed?
- Does the paper demonstrate adequate use of evidence, informational input or other intellectual raw materials in support of its case?

REFEREE COMMENTS:
The research sample needs more details

6. Data Analysis and Use of Data

- Has the interpretative potential of the data been adequately realised?
- Has the data been used effectively to advance the themes that the paper sets out to address?

REFEREE COMMENTS:
Nothing is mentioned about the reliability and validity of the research tools and how they been constructed

7. Use of Theory

- Does the paper use theory in meaningful way?
- Does it develop or employ theoretical concepts in such a way as to make plausible generalisations?

REFEREE COMMENTS:
Adequate

8. Critical Qualities

- Does the paper demonstrate a critical self-awareness of the author's own perspectives and interests?
- Does it show awareness of the possibility of alternative or competing perspectives: such as other cultural, social, political, theoretical or intellectual perspectives?
- Does it show an awareness of the practical implications of the ideas it is advancing?

REFEREE COMMENTS:
Adequate

9. Clarity of Conclusions

- Are the conclusions of the paper clearly stated?
- Cohesiveness of paper: do the conclusions adequately tie together the other elements of the paper (such as theory, data and critical perspectives)?

REFEREE COMMENTS:
This section is very weak. It is a kind of paraphrasing of the presentation of the results. There is no discussion or conclusion at all

10. Quality of Communication

- Does the paper clearly express its case, measured against the technical language of the field and the reading capacities of an academic, tertiary student and professional readership?
- What is the standard of the writing, including spelling and grammar? If you will be recommending publication with revisions, please make specific suggestions or list errors.

IMPORTANT, PLEASE INDICATE:
[ ] From an editorial point of view, this paper is of a publishable standard as is.
[ ] This paper requires minor proofing by a colleague or critical friend of the author.
[ ] This paper requires thorough reworking by a professional editor. (For instance, where the author's first language is not English.)
REFEREE COMMENTS:
Please check format of references.

Examples
Last, First, and Given Family. *Title, 1995–2002.* New York: Publisher, 2002
Last, First, and First Last. "Article Title." *Journal Title* 3 (May 1996): 47
Last, First. "Dissertation Title." Ph.D. diss., The University of Melbourne, 2002
Last, First. "Article Title." In *Book Title,* ed. First Last. City: Publisher, 2002

Comments and critical suggestions on the content and structure of this referee format are most welcome. Please email kathryn@commongroundpublishing.com.

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PAPER FOR REFEREEING

Following is the paper for refereeing. If you, as referee, wish to annotate the text, please indicate with an ‘X’ as follows:

[X] I have not annotated the text.

[ ] I have annotated the text. The method of annotation I have used is: ......

Please indicate here the way in which you have annotated the text, for instance, BLOCK LETTERS, or red text, or by using the ‘changes tracking’ function in Microsoft Word.

Learning Science Through Computing

This paper presents our recent experience in teaching an undergraduate course, Introduction to Computational Science, in which we combine science and computing to form an interdisciplinary course. This is a lower level computational science course, and it contains applied math, programming, and science, with a focus on solving scientific problems by computer simulation and modeling. The purpose of doing this is to stimulate students' interest in science and computing. Under traditional view, math, science and computing are considered as different categories. Now we put them together to demonstrate that computational methods and models can be applied to solve real world problems and design sophisticated systems. Students learn science by simulating physical events using computer software Interactive Physics and building scientific project applying Python Turtle graphic unit. In the meantime, they can increase their interests and improve their skills in programming, by realizing that computing skills are important not only to computer science majors as well as to other majors such as business, art, English, history, etc., since these skills can be used in their own disciplines. We thus achieve our goal of teaching important computing concepts to students, who are satisfied that the computational skills they learned from the course are relevant to their daily life and can be used in their future development.

Keywords: Computational Science, General Education, Interdisciplinary Course

Introduction

Over the years, scientific discoveries and advancements have shaped our world and lives. The impact of science and the technologies it has spawned is evident everywhere, from the food that we eat, the clothes that we wear, the house that we live in, the cars that we drive, to digital-electronic devices that we depend on to keep us informed and entertained [1]. It is widely recognized that in order to maintain sustainable prosperity, maintain a high standard of living, preserve our infrastructure and environment, it is imperative that a highly trained technical workforce should be prepared to adapt to and to promote further scientific and technological advances. A recent report [2] presented to the U.S. Congress indicated that the U.S. Bureau of Labor Statics projected that employment in science and engineering fields would increase at a faster rate than other professional groups from 2006 to 2016. According to a U.S. government report prepared in 2008 [3], however, science, technology, engineering, and mathematics (STEM) education, the main driver for training the technical workforce, does not provide a sufficient number of students, teachers, and practitioners in STEM areas. The report concluded that the math and science achievement of U.S. secondary school students and the rate of STEM degree attainment are inconsistent with the nation's role as the world leader in scientific innovation [3]. For example, the report cited a 2003 international assessment in which 15-year-olds in the United States ranked 24^{th} in science literacy and 28^{th} in math literacy, and the U.S. ranked 20^{th} among all nations in the proportion of 24-year-olds who earned degrees in natural science or engineering. As a consequence, many entering college students are simply not prepared for college level STEM education or may not be able to pass STEM courses with a successful grade. A significant number of college students have to take remedial math and science courses to be prepared for college level courses. According to a 2006 report by the National Science Board [4], more than 20% of college freshmen take remedial level math and science courses because they are not ready for college-level work, caused partially by the rising immediate college enrollment rate. It is obvious that innovative ways of teaching in STEM education is necessary.

Computational Science at Brockport

The College at Brockport, State University of New York (SUNY Brockport), is predominantly a four-year comprehensive liberal arts college and belongs to the category of a primarily undergraduate institution. The college offers both the baccalaureate and master degrees in arts, humanities, social sciences, natural sciences, and professional studies. In the last five years, the college steadily hosted about 7,000 undergraduates and 1,000 graduates. For example, in the fall of 2010, there were 7,297 undergraduate students (56% female) and 1,292 graduate students (67% female). In the past decades, the college has supported numerous efforts to increase STEM enrollments, enhance diversity, and promote the culture of research at Brockport. A goal of the College is to expand its academic units to include new science and technology oriented programs to meet the workforce demand in STEM fields. It has recently included computational science and environmental science to its academic programs. In the fall of 1998, SUNY Brockport began offering both undergraduate and graduate degrees in computational science, in the hope that the interdisciplinary computational science can train students to have multiple skills of math, science, and computing. Core areas of computational science include computational tools, high performance computing, applied and computational methods, simulation and modeling, visualization, application sciences, and communication [5].

Since the establishment of the program, the computational science (CPS) faculty has revised its curricula five times and developed thirty new courses to support various degree options of BS, MS, and BS/MS [6,7]. The interdisciplinary core of computational science degrees puts CPS students at an advantage position, because not only employers want their employees to have multiple set of skills, but also students are highly likely being employed outside their field of study in the future. As a result of enabling interdisciplinary core, a half of CPS majors are working on degrees in multiple STEM fields, such as math, computer science, or physics, and several students graduated with triple majors [5].

The Department of Computational Science, led by Dr. Yaşar, established an institute, participated by members from other departments and local/national institutions, supported by a National Science Foundation (NSF) grant, which advocates the Computational approach to Math, Science, and Technology (CMST) education, both as a novel strategy to improve the technical workforce and as an effective pedagogy for classroom teaching [8,9].

General Education in Natural Science

Students are introduced to computational science by CPS 101, Introduction to Computational Science. The object of the class is to explain what computational science is, how CPS skills can be learned, where CPS techniques are applied, and why CPS is used to solve complex real world problems. The contents of the course include applied math, programming, and science. This course satisfies the college general education requirement, and the prerequisite is college algebra, which is required by almost all admitted students. As a result, students from other disciplines on the campus also enroll in the class. Students vary in their areas of study, including mathematics, computer science, physics, computational science, environmental science, meteorology, business, criminal justice, etc. It was originally developed and taught by Dr. Yaşar, and Fortran 90 was used as the primary computer language. Since fall 2007, Shen has been teaching this course, and more attention has been paid on programming in C computer language.

In fall 2010, the class was further classified as a general education course in natural science to outreach science and computing to broad students on the campus, and more science contents have been added in the syllabus. We do see increased enrollment since the change, as shown in Table 1. The pedagogy of teaching is changed to contextual education, putting science and computing in practical domains [10]. To meet the needs of students with various backgrounds, a contextual learning is critical for students' success. A contextual introduction to CPS could improve its attraction to a wider audience while generating more enthusiasm towards sciences [8]. A user friendly software tool Interactive Physics was used to teach a number of topics in physics, and the script language Python was used to teach computing concepts.

Table 1: Number of enrollments for CPS 101 in the past four academic years

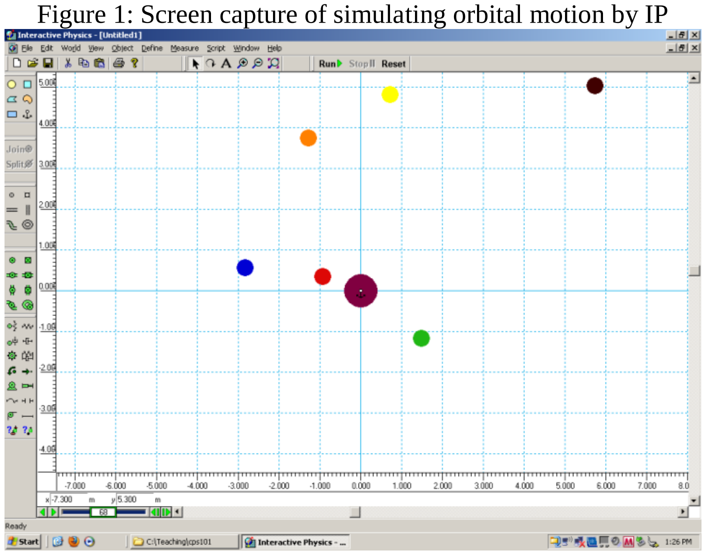
Academic year	2007-2008	2008-2009	2009-2010	2010-2011
Enrollment	14	14	12	23

Teaching Physics Using Interactive Physics™

A number of physics topics are covered in CPS 101, including falling objects, trajectory of projectile, harmonic motion, orbital motion, Newton's second law of motion, etc. More advanced topics will be covered in lectures in the near future. The award-winning, user-friendly, easy-to-use educational software from Design Simulation Technologies, Interactive Physics™ (IP) [11], is used as the primary computational tool for teaching important physics concepts. A satellite license of IP has been bought for campus computers at SUNY Brockport through NSF funded CMST Institute. IP provides an appealing visual interface for users to model, simulate, and explore a wide range of physical phenomena. Students and educators are able to build physics project, conduct digital experiment, and investigate physical events without deeply knowing or memorizing the laws of physics. Users are allowed to set up their own physical world, choose physical parameters, and create control buttons to facilitate simulation.

A virtual reality of a physical experiment can be established through a careful design, and students can monitor the position, velocity, energy, and elapsed time of a system being simulated. IP can not only provide dynamic visual effect, but also export simulation results in numerical format to analysis tools such as Excel for data analysis. Practitioners can actively interact with the software and control the simulation process. A big advantage of the IP is what you see is what you obtain. The software program (IP) greatly enhances physics instruction and builds students' confidence and success in learning. A screen shot of simulating orbital motion is shown in Figure 1. The use of IP tool is straightforward, and students are able to build their own projects after a couple of weeks training.

Figure 1: Screen capture of simulating orbital motion by IP



Programming by Python

While IP is a good tool to expose students to may physical concepts, computational STEM education needs to move beyond just using tools. One of the main purposes of computational STEM education is to stimulate students' interest in science, math, engineering, and computing, to encourage learners to think deeply, and to prompt them to solve challenge problems. Previous experience with computational science indicates that students need to eventually understand the underlying mechanism of simulation and modeling and to flexibly master and utilize acquired knowledge rather than practice rote memorization of scientific laws [8,9]. They will be required to model a physics phenomenon by computer simulation using IP, and solve the same problem by writing a computer code using a computer language.

A scripting and interpreted language such as Python is chosen to replace a compiled language such as C as the primary teaching language. The choice is based on three major reasons. The first consideration is how soon the language can be learned. The learning curve of Python is relatively flat, witnessed by shorter programs, less error-prone code, and shorter development time. It can be learned in a couple of weeks for basic operations. The second consideration is how easily the language can be implemented. Python is open source platform-independent software, and it can be downloaded and installed on Windows, Unix/Linux, or Macintosh computers free of charge. A Python program can be executed in either an interactive mode or a file mode. A good practice is to test an individual statement or a single structure using the interactive mode, and write a complete program in the file mode. The third consideration is how broad the language can be used. Python is a general-purpose, object-oriented, high-level programming language, which provides extensive standard libraries and supports the integration with other languages and tools. It is increasingly used in scientific computing, web development, and database operations. Its application in scientific computing is supported by the fundamental packages of SciPy and NumPy. The full capacity of Python is beyond the scope of this paper. In short, Python is the idea teaching language for CPS 101, the majority of which typically does not have any prior programming experience.

Even though Python is designed as an object-oriented program language, we focus on procedure-oriented program for an easy start. We begin Python program by introducing the basic syntax, the input and output functions, the data objects, and simple mathematical, logic, and relational operations of the language. A lot of time has been spent to teach students the building blocks of a Python program, the sequential, selection, and repetition structures. This kind of exercise is very important for them to develop computational and logical thinking in their mind. After learning the basic components of Python language, they were instructed to write their own code to solve a number of physics problems, such as falling objects, trajectory of projectile, harmonic motion, and orbital motion, using a simple algebraic formula, $new = old + change$, proposed by Dr. Yaşar [6,7].

In the physical world, the relationships between velocity (v) and displacement (x), acceleration (a) and velocity are as follows

$$v = \frac{dx}{dt} \text{ and } a = \frac{dv}{dt}. \qquad (1)$$

Acceleration and external force are related by Newton's second law of motion, $F = ma$, where F is the external force, and m is the mass of an object. For the harmonic motion of a spring, the force can be calculated as $F = -kx$, where k is the spring constant, and the acceleration is $a = F/m = -kx/m$. For falling objects, trajectory of a projectile, and orbital motion, a is simply the gravitational acceleration. Equation (1) can be rewritten in discrete form as,

$$x_{new} = x_{old} + v \cdot dt \text{ and } v_{new} = v_{old} + a \cdot dt,$$

where $v \cdot dt$ and $a \cdot dt$ are the changes of position and velocity, respectively. A simple numerical algorithm can thus be constructed to predict the position and velocity at any time for an object in two-dimension, as shown in Algorithm 1.

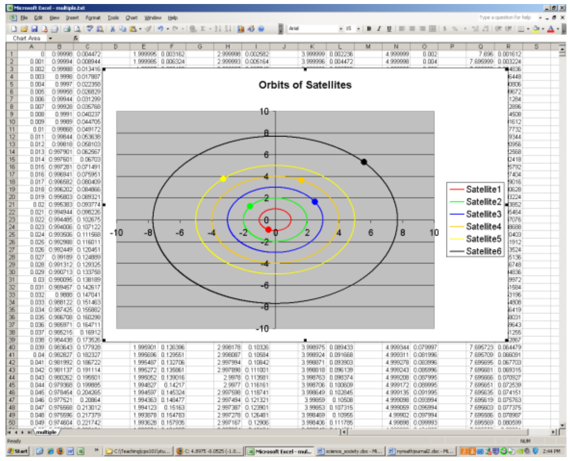
Algorithm 1: Procedure for simulating Newtonian motion in two-dimension

İnitialize velocity $v_{x,old}$ *and* $v_{y,old}$
İnitialize position x_{old} *and* y_{old}
İnitialize time step dt
İnitialize time t
İnitialize maximum time $t\_\max$
Initialize force F_x *and* F_y
İnitialize mass m

While $t <= t\_\max$ *:*
- *Calculate acceleration in x direction* $a_x = F_x / m$
- *Calculate acceleration in y direction* $a_y = F_y / m$
- *Calculate velocity in x direction* $v_{x,new} = v_{x,old} + a_x \cdot dt$
- *Calculate velocity in y direction* $v_{y,new} = v_{y,old} + a_y \cdot dt$
- *Calculate position in x direction* $x_{new} = x_{old} + v_{x,new} \cdot dt$
- *Calculate position in y direction* $y_{new} = y_{old} + v_{y,new} \cdot dt$
- *Update* $v_{x,old}$ *as* $v_{x,old} = v_{x,new}$
- *Update* $v_{y,old}$ *as* $v_{y,old} = v_{y,new}$
- *Update* x_{old} *as* $x_{old} = x_{new}$
- *Update* y_{old} *as* $y_{old} = y_{new}$
- *Updata* t *as* $t = t + dt$

The above algorithm can be easily reduced to one-dimension or extended to three-dimension. The predicted positions of x and y, velocities of v_x and v_y can be printed on computer screen, or saved in a file with ASCII format, which can be loaded to Excel for curve plotting. A screen capture of Excel worksheet to display results from Python program is shown in Figure 2.

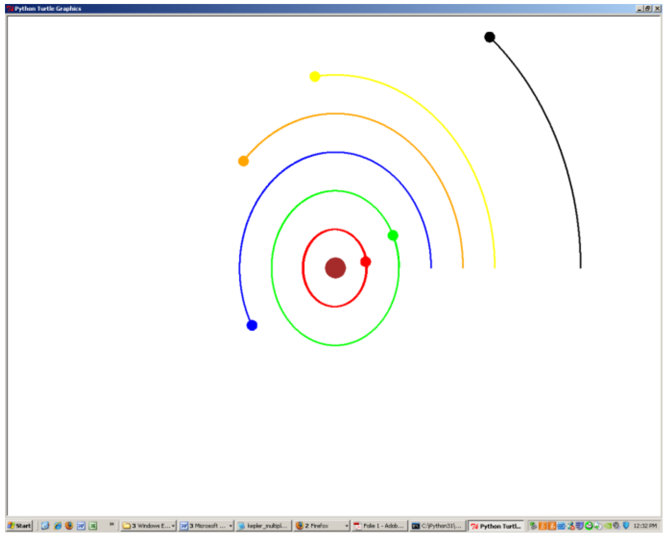
Figure 2: Screen capture of Excel worksheet displaying numerical results from Python



Programming with Python Turtle Module

Writing Python programs in the standard file mode is less welcomed by students who do not study computer/computational science. The computed data need to be imported to Excel for visualization. To make writing computer programs interactive, create attracting visual effects, and reveal how IP software works, a graphic representation is introduced. The Turtle module is applied to serve this purpose. Turtle graphics is a popular way for teaching programming to people who are beginning learners. It allows one to write a program and manipulate geometry intuitively. Turtle graphics primitives are supported by the turtle module in both object-oriented and procedure-oriented ways [12], and the underlying graphics is provided by Tkinter. Therefore, in order to use Turtle module, Python must be installed with Tk support. The Turtle module supports a number of functions for moving, drawing, and controlling, such as *forward(), backward(), position(), color()*, etc. When any of these functions are called, a pen and a canvas are automatically created as the procedural interface. To simulate orbital motion or produce the trajectory of a projectile, only a few graphics functions need to be called, such as *setworldcoordinates(), pencolor(), pu(), goto()*, and *pd()*, and inserted in Algorithm 1 at the appropriate location. A screen capture of Turtle graphics representation of orbital motion is shown in Figure 3.

Figure 3: Screen capture of orbital motion by Turtle graphics



Results and Discussions

Computational approach to STEM education presents an alternative and effective way of learning science, and brings students close to reality through modeling and simulation. It certainly reinforced the visual effect in the classroom and can capture students' attention with an easy effort. The use of Interactive Physics has greatly enhanced students' understanding of concepts learned in science classes. Teaching STEM courses in the context of application provides a convenient way to reach students who do not enjoy math or science, since they have a chance to manipulate mathematical formulas and construct geometry and feel that science and math concepts are not completely out of control. It is likely that they might take more advanced courses in science and math.

The class materials have been presented in the order of foundations of computing, basics of applied math, IP simulation of physics topics, and Python programming. After the computational tools were introduced to the class, a significant improvement of students' behavior and participation has been observed. They came to the computer lab in advance, and did not skip the class as often as they usually did. Students were highly engaged in class activities and actively involved in practicing different computer tools.

The use of computational approach enhances students' capability of problem-solving. A project was given to the class to simulate a flying baseball, find out how the initial speed and throwing angle affect the maximum vertical and horizontal distances it can reach, and determine the optimal angle that a batter should hit a baseball. They need to make the simulation using IP and produce the trajectory for different initial velocities and flying angles, then solve the same problem by writing their own Python program, and finally visualize the flying baseball using Python Turtle graphics package. It is hardly to image that such a project can be completed if computational tools and techniques were not applied.

While computational techniques have been shown as an effective way to promote science education, now it is time to argue that computer simulation is a catalyst for learning programming as well. To simulate the orbital motion of an object, a number of variables are needed to store time, time increment, acceleration, velocity, and position; to predict the velocity and position at next time step, mathematical operations were used for calculation; to find the relations of velocity or position with respect to time, a loop has to be used to perform repeated calculations; to ensure correctness, the calculations of acceleration, velocity, and position have to be put in a sequential while logically right order. Various programming skills that have been taught in the class are required to solve the problem. In the context of application, it is easy for students to understand why and how to learn computer program, it is safe to say that they are more willing to learn computer program, even though it is hard for many of them, and it is convenient for them to realize that computing skills are important not only to programmers but also to scientists, engineers, mathematicians, accountants, etc. It is hoped that curiosity-driven learning stimulated by computational approaches will be evolved to mission-directed study for many, if not all, students.

Conclusion

The recent practice of teaching an introductory computational science course as a part of general education in natural science to students with various knowledge background indicates that computational approach is a promising means of enhancing STEM education. When computational tools are used, students are more engaged in the class, and their attitude toward learning is more active. Solving real world problems by writing computer programs urges students to acquire knowledge through scientific inquiry beyond memorizing laws of science, encourages them to spawn ideas of computational thinking, and fosters them to develop habits of scientific thinking. The major contribution of computational approach to STEM education is that it integrates math, science and computing in a single unit, exposes and trains students with multiple skills, which are useful in their future careers.

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