Personalized System of Instruction (PSI) : Factor Analysis

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Personalized System of Instruction (PSI)

——ファクター分析——

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Personalized System of Instruction（PSI）別称ケラープランは，1963年アメリカの心理学者Dr. Fred S. Kellerによって提唱された高等教育の歴史に残る教授法である。1960～70年代，アメリカを主とする多数の国で驚異的な指示を得，応用された授業科目も多岐にわたった。

本稿は，PSIの特質のうち特に ⑴セルフペースとプロクラスティネーション ⑵学生プロクターの使用 ⑶試験 ⑷評価 ⑸コンピューターの使用の５点に関して，ファクター分析を試みるものである。最後に，PSIの代替として用いられるいわゆるSLIについて論じる。

1. Introduction

The Personalized System of Instruction (PSI), also known as the Keller Plan, was conceived by an American psychologist, Dr. Fred S. Keller, in 1963. It was first offered in higher educational institutions in the United States and Brazil; then it was soon introduced in many other countries. In 1974, while acknowledging his list was incomplete, Keller (1974a) reported its use in Canada, Mexico, Africa, Argentina, Australia, England, India, Ireland, Israel, the Netherlands, New Zealand, Portugal, Samoa, Spain, and Tasmania.

PSI seemed to first appeal to those who taught courses with goals that were well defined in terms of knowledge or skills to be imparted such as physics, engineering, mathematics, statistics, chemistry, biology, sociology, and English. However, it was soon adopted in various courses. They were: anthropology, anatomy, astoronomy, accounting, art, and architecture; biology, biochemistry, and business administration; computer science, control systems, and conditioning; drafting, and design; embryology, ecology, electricity, evolution, and economics. Naming these courses, Keller (1974a)

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confessed:

> There is hardly a field of study that can be mentioned in which someone does not use the system at one or another level of instruction. The question of keeping track of this development in any detail becomes less realistic with each day (p.6).

Five characteristics that Sherman (1974) states distinguish PSI from conventional teaching procedures are: (1) mastery learning, (2) self-pacing, (3) a stress on the written word, (4) student proctors, and (5) the use of lectures to motivate rather than to supply essential information.

This researcher has already introduced the history and educational system of PSI, and the significance of its use at Japanese universities (Shinohara-Egawa, 2000). She also discussed "Mastery Learning," one of the major components of PSI, in comparison with mastery learning of "Learning for Mastery (LFM)" developed by Benjamin Bloom in 1968 (Shinohara-Egawa, 1998).

In this paper, the researcher attempts to discuss other features of PSI by reviewing published literature. They are: self-pacing and procrastination, use of student proctors, testing, grading, and use of computers. Through this study, she believes the applicability of PSI at Japanese universities will be more evident in some way.

2. Self-Pacing and Procrastination

Self-paced learning allows students to complete assignments and to arrange for appropriate tests of achievement at their own speed. Students differ in ability; therefore, they master PSI units in different amounts of time. This appears to be an ideal learning strategy. However, classroom teachers who attempt to apply unlimited self-pacing often have to struggle with the problem of student procrastination.

When students know that they are always permitted to take a retest, they do not force themselves to study for the initial test. They procrastinate until the end of the course and then become overwhelmed by all they have yet to accomplish. In other words, they "follow a general law of human behavior: whatever can be put off, will be" (Kulik, Jaksa, & Kulik, 1978, p.9).

The longer a student delays course work, the more difficult it can be to accomplish it. As a natural result, the student withdraws from a class, or gets "Incomplete" at the end of the course. PSI has been often criricized for its high dropout rate and high "I" grade rate (Cross & Semb, 1976; Davies, 1983; Kulik, Jaksa, & Kulik, 1978; Kulik, Kulik, & Cohen, 1979; C. Kulik, J. Kulik, & Bangert-Drowns, 1990; Miller, Weaver, & Semb, 1974; Seiler & Fuss-Reineck, 1986; Semb, Glick, & Spencer, 1979; Wesp & Ford, 1982; et al.).

Methods of dealing with student procrastination have been a topic of many articles concerning PSI. First, many teachers attempt to solve the problem by giving instructor-paced mass-testing instead of self-paced individual-testing. In fact, according to three research results (Goldwater & Acker, 1975; Morris, Surber, & Bijou, 1978; Wesp, 1986), course achievement in an instructor-paced testing group was better than that of a self-paced testing group, or no differences were found. Since it is obvious, as Gluckman (1973), Hobbs (1981), and Schiller and Markle (1978) point out, that self-paced systems also create administrative problems such as scheduling difficulty, and too many teacher clerical chores, this instructor-paced mass-testing seems to solve a lot of problems the self-paced system causes.

However, considering the importance of the self-paced testing system as a component of PSI, an instructor-paced testing system seems to neglect a vital advantage that the self-paced system has. That is the teaching of self-managing skills, in other words, the shift of control from the teacher to the student. Williams stated:

> Keller believed that if all courses were taught using the self-pacing component students would quickly learn that if they are to complete college they would need to develop important self-management skills (e.g., determining accurately the time, extent, and distribution of study, when to take tests, etc.). . . . If these self-management skills are learned, then important behaviors, besides knowledge of course content, will have been taught. (1976, p.108)

When the so-called Humanistic Approach became very popular in education in the 1970s and 80s, the originators of the various innovative teaching methodologies considered education not only as a means to convey informational knowledge but also something used to help a person grow into a mature human being. The originators cared about how students felt about their teacher, their class, their textbook, and their overall learning experience. Examining the PSI testing system from this point of view, it can be said that the growth of students' self-control and self-reliance should have the first priority.

Then, what are techniques to discourage student procrastination? First, about the course material, Keller and Sherman (1974) gave the following suggestion:

> (1) The units of our course may be too large, especially at its beginning. An assignment that can be mastered in two hours will fit within a student's daily activities better than one that asks for four. It may arouse less fear and less avoidance of the task, and it can more easily compete with other time-consuming and equally rewarding matters. (2) The unit or units may be too difficult in content, producing successive failure and lengthening the time required to pass. (3) The material to be studied may lack intrinsic interest (may have too few built-in reinforcements) and be unable to compete with more absorbing matters in the academic sphere or elsewhere. (p.90)

Also the following are some other classroom techniques suggested by other researchers:

(1) A schedule of dates is provided to the students at the very beginning, indicating by which day students are recommended to pass each unit in order to complete the course by the end of the semester. This greatly helps students to pace themselves. (Jumpeter, 1985; Seiler & Fuss-Reineck, 1986; Wykoff, 1980)

(2) When students complete course materials by the appropriate date, a fixed number of bonus points are added to their final grades. (Hursh, 1976; Lamwers & Jazwinski, 1989)

(3) When students cannot complete course materials by the appropriate date, they lose points, grades, or course credit. (Hursh, 1976; Lamwers & Jazwinski, 1989)

(4) The students who finish materials before the end of the term or semester are offered an early final with available retakes. (Hursh, 1976)

(5) A graphic feedback on student progress is provided. (Hursh, 1976)

It appears that Keller and Sherman consider the problem of procrastination as a teacher's technical problem rather than the students' problem, because they resumed the chapter on procrastination in the Handbook with the comment:

> The time is fast approaching for a reevaluation of what constitutes a course of study, when it may be taken and by whom, what credit (if any) should be given for its completion, and how it should be paid for. When these things have taken place, procrastination will be the least important of our problems. (1974, p.91)

3. Use of Student Proctors

Sherman (1974) defined the proctor as "not only an essential feature but perhaps the most valuable contribution of PSI" (p.25). In fact, Hursh (1976) explained:

> The use of other students (called proctors, teaching apprentices, student managers, tutors, among other titles) in an instructional capacity makes possible the operation of personalized courses with large numbers of students. Without proctors it is impossible for an instructor to handle more than a dozen students and still maintain unit-by-unit quizzing, a mastery criterion, and student pacing. (p.98)

While proctors release instructors from everyday clerical chores, they can also allow the teachers to devote more of their time to and concentrate on individual students and problems that require their level of expertise. As a result, according to Finn (1983), the system of proctors can ideally solve the problems of (1) procrastination, (2) inadequately prepared materials, and/or (3) difficulties in understanding the course content.

On the other hand, some serious problems dealing with the use of proctors have been also reported

in the literature. First, Caldwell (1985) discussed the problem of cheating as follows:

> . . . it is very possible that the degree and ease of proctor shaping depends on who the student is (e.g., a handsome football player and a female proctor; a beautiful young lady and a male proctor) and what consequences result from the shaping. If a proctor is easily shaped and shaped to accept rather remote approximations, we would probably call it cheating. In a typical PSI course in which no cumulative final is given, the consequences are probably highly positive. (p.11)
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> . . . in many cases the tutors cheated for a person who was virtually a total stranger. Furthermore, they cheated and, in many cases, the student didn't even know it. The students thought they were getting 90% or better when in fact they were scoring as low as 60%. When confronted with our knowledge of the situation, the tutors could only offer explanations indicating that they felt sorry for the students because their record cards showed that they had failed so many quizzes, or they wanted to be "good" to them, or "cut them, a break." (p.11)

Couch, Ober, and Merrill (1984) described the problem of proctor absences. They stated that proctor absenteeism was a continual problem in their PSI course because the proctors' daily responsibilities were not convered. In the case of Lu's experiment (1976), the lack of sufficient proctor training affected the course effectiveness. Their proctors' basic knowledge was derived only from an assignment to read Keller's article. Finally, Hobbs (1987) asserted that proctors became a barrier between students and instructors. Rather than using the system to increase student-teacher interactions, instructors could use proctors to minimize contact with their students.

In order to avoid these disadvantages of the proctor system, researchers tried out various modified approaches. For example, Finn (1983) adapted a Student-Student component in addition to the proctor system. He divided the class into groups of three to five students, and made each group attend a mandatory one-hour meeting in class once a week. The purpose of these meetings was for the members of the group to assist any other member/s who was/were still working on the earliest common unit. Finn concluded the report:

> . . . it is doubtful that students in a PSI course are more naive about the performances of their colleagues compared to students learning within any other instructional mode. For college students at least, it appears that some peer pressure and competition for grades are present no matter what the method of teaching is, and how a student reacts to these depends more upon her/his own past history in adjusting to these pressures than upon the particular teaching method. However, one of the strengths of the PSI method lies in attempting to minimize these pressures because of the personalized approach to each student's needs, while at the same time allowing the student the opportunity to maximize her/his learning. The introduction of the student-student component was felt to add one more feature to the system by which these pressures might be further reduced and learning increased because of the typically informal nature of "give-and-take" sessions among students, the positive feelings generated in students who can take pride in helping their

> colleagues and who, in return, find themselves learning the material more completely by doing so, and the positive feelings of the students who are receiving the help they need without the apprehension and self-consciousness often felt in student-proctor and/or student-instructor interactions.(p.43)

Hursh (1976) introduced the system applied by Johnson and Sulzer-Azaroff. They set up three conditions for the courses: (1) class used proctors from previous semesters (called "external proctors") + students were assigned to one proctor throughout the course (called "constant"); (2) class used proctors from previous semesters ("external proctors") + students were allowed to go to any available proctor (called "variable"); (3) class used students from within the course ("internal proctors") + students were allowed to go to any available proctor ("variable"). Their results demonstrated no difference among those three in their performance. However, students in type (2) and (3) classes reported that they preferred the internal proctor and variable type of arrangement.

Bono and McAvoy (1977) assessed the classes with a self-grading procedure and a proctor-grading procedure in PSI. More concretely, the purpose of the study was to determine: (1) after being exposed to both self- and proctor-grading procedures, which condition students would prefer, and (2) in which condition students would perform better. The research results presented all performance measures for the two groups as highly similar. Also on a course evaluation questionnaire, students rated the proctors and the opportunity to choose their grading system highly.

Finally, going to extremes, Boren and Foree (1977) utilized no proctors: the students worked independently but had one-to-one contact with the instructor for assistance during the scheduled class time. They had a positive research result.

4. Testing

In typical PSI courses, students demonstrate content mastery through multiple test taking procedures. This testing has been, for educationalists using PSI, one of the biggest objects of scientific study.

Many researchers conducted research on PSI testing in college courses, and found that frequent testing was very effective for the students' mastery of the subject (Abbott & Falstrom, 1977; Badia, Harsh, & Stutts, 1978; Barkmeier, Duncan, & Johnston, 1978; Dorsel, 1980; Stauffer, 1973; Sussman, Valente, & Mao-Cohen, 1980; Ulman & Sparzo, 1978; Watson, 1985; Williams, 1976; at el.). Kulik and Kulik (1987) even assured that:

> A reasonable inference to draw is that the high level of achievement often found in PSI courses may be largely attributable to the mastery testing requirement in PSI courses.

> Other special features of PSI courses. . . may not be so important for stimulating outstanding student achievement. Such factors may be important for attitudinal and other effects produced by PSI, but the learning effects of PSI may be traceable to mastery testing alone. (p.340)

It is interesting to note that there are many other researchers who also examined the effectiveness of frequent testing in college courses that were not PSI courses (Dustin, 1971; Gaynor & Millham, 1976; Glucksman, 1973; Mawhinney, Bostow, Laws, Blumenfeld, & Hopkins, 1971; Rohm, Sparzo, & Bennett, 1986; et al.), and they all reported positive results with regard to the students' achievement. This fact verified that frequent testing in itself works; therefore, it may also be a substantial component of the success of PSI. The noteworthy findings in those studies were:

(1) The number of retests that students are allowed to take can be limited to reduce students' procrastination (Barkmeier, Duncan, & Johnston, 1978; Sussman, Valente, & Mao-Cohen, 1980). Barkmeier, Duncan, and Johnston's research results showed:

> . . . when students are given a practically unlimited or very high number of test opportunities, they engage in less preparation for initial tests than when the number of retests is more limited. As a result, when allowed five attempts, students took 45% more tests on each unit than when limited to two tests per unit. However, even with fewer attempts-per-unit, the greater amount of study and higher score on the first attempt contributed to essentially the same final level of performance on all units for students performing under the two-attempt condition compared with the performance under the five-attempt condition. (1978, p.91)

(2) Retesting, no matter how effective the teaching device, is still a terribly time-consuming procedure for an instructor. The clerical chores such as writing the extra tests, scoring, bookkeeping, and filing are reduced if less frequent testing is done (Glucksman, 1973).

5. Grading

Ideally, all PSI students who pass all units and pass the final exam should be given grade A with an alternative of an "Incomplete." However, in practice, it is often difficult to carry out. Davies, from his own experience, pointed out the problem as follows:

> The higher percentage of incomplete found in PSI courses raises several problems, most important of which are the costs associated with the encumbering of faculty and administrative time to correct incompletes. When I allowed incompletes, students took advantage of this outlet. When I barred incompletes, there was no evidence of an increase in the failure rate. More students took the option of the pass-fail credit route for the PSI. Regardless of whether a high or low pass-fail requirement was imposed, my students extended their energies sufficiently to the pass level set. (1983, p.122)

Basides a pass-fail credit system, there is another alternative grading system that Sherman (1974) suggested. He explained the system as follows:

> For example, in a twenty-unit course the student passing all twenty units would receive an A and the normal three credits associated with that course. The student successfully completing fifteen units would also receive an A but only two credits; the student finishing ten units might receive only one credit, but again with a grade of A. This system recognizes that the student has met a high standard and also indicates what proportion of the course has been mastered. (p.35)

Whatever system is applied, it appears that ease of administrative treatment must first be examined as well as pedagogical effectiveness.

6. Computers and PSI

Keller supported the idea of using a computer under PSI, as well as a programmed text, a teaching machine, or a closed-circuit television, and stated that they may even be desirable at times. He also asserted that "such devices are not to be equated with the system itself" (1974b, p.19). Obviously he regarded the use of a computer as a subordination to the system of PSI. However, there is no reason why we cannot consider the active implementation of Computer-Assisted Instruction (CAI) in PSI classes. It can be easily supposed that if PSI and CAI are applied in one class on an equivalent basis, though it may exceed Keller's idea, great educational effectiveness can be expected.

Then, how can computers be wisely used in the PSI system? Believing that the proctor should be used in a way that fully utilizes the complex judgments only a human can make, Sherman (1974) explained:

> When a proctor's function is merely to check off answers as "right" or "wrong", he could in fact be replaced by a machine. Then the course is no longer a PSI course and a great opportunity has been lost. (p.33)

Looking at this statement from another point of view, it also can be said that successful management can be done by giving computers all the work computers can do. If proctors are used to do solely the work that can be done by only a human, then proctors can concentrate on that kind of work, and better results can be expected.

A good example of the above was introduced by Wykoff (1980). It was the case implemented by the Mathematics Department at Western Michigan University. They used the computers for:

(1) making many versions of exams on the same material. A computer program was used to select 20 questions for each test from a library of over 1,000 questions.

(2) scoring exams immediately upon completion. It was possible because the exams were all

multiple-choice.

(3) the extensive record-keeping demanded by a student population of over 1,000 taking an average of one and one-half exams per module.

(4) producing the progress reports, listings of the students who did not meet the test schedule, and notes to those students to advise them of their status.

On the other hand, their graduate assistants met with an assigned group of students three times a week for 50 minutes, and supervised them by monitoring the progress of those students.

Skinner (1988) did research that determined the attitudes of college students toward working with CAI in the context of a PSI course. He found that these research results strongly supported previous research efforts that have determined that college students overwhelmingly demonstrate positive perceptions and attitudes toward CAI. As responsible reasons, he pointed out the following three factors:

(1) Students tend to perform well on quizzes and tests as a function of CAI. For example, achievement data indicated that student performance under CAI conditions averaged 88.9% on unit quizzes as compared to an average of 81.6% under Text-Only conditions. Students are apt to demonstrate positive attitudes and perceptions toward methods that result in higher academic performance, and this is the case.

(2) Students like the interactive nature of CAI. CAI provides more opportunities to respond during instruction than other methods.

(3) CAI creates a safe and comfortable learning environment for students. First, students are allowed to progress at their own pace in most CAI programs at the college level, especially when they are combined with PSI: Second, they feel safe when making and learning from mistakes made under CAI conditions.

In short, a computer is capable of managing all the complicated and troublesome clerical work PSI demands, and CAI appeals to students for a number of reasons, while proctors can make the instruction more humanistic. The combination of PSI and CAI should work out perfectly.

7. "Something Like It (SLI)"

Although there are hundreds of research reports on PSI, the number of studies that implement all the components of PSI is unexpectedly small. Keller and Sherman (1974, p.78) coined the word "SLI" that was an abbreviation for "Something Like It" for the variations of PSI that do not include all the components of PSI. Even though better-sounding terms were suggested by other researchers

such as "MSI (Modularized System of Instruction)" by Gindler, Marosz, and Romano (1977), this ironical name (SLI) became widely spread. Sherman (1974) stated:

> It is tempting to challenge from the outset one or more of the essential features of PSI. The doubt may even be well taken, but it is a poor way to start. Research, which is increasingly taking the direction of a component analysis of the system, is now experimenting with deviation of why PSI works and perhaps gain some ranking of the importance of the essential characteristics. This information will form a date base for making logistical decisions and should eventually lead to the designing of a better system. But initially, those new to PSI might do well to accept the defining characteristics as given and take a conservative position with respect to logistical decisions. Some "small" changes have led to major difficulties. The basic format works. (p.47)

While Keller and his followers asserted the importance of application of all features of PSI again and again (Keller & Sherman, 1974; Keller, 1974b; et al.), it appears that researchers preferred to continue experimenting with SLI and analyze which component of PSI was most effective. This was probably because: (1) researchers liked to carry out studies for research *per se*, and SLI was an easy subject for that, and (2) administratively it was not easy to apply all the components of PSI in a traditional school system; therefore, it was necessary to find out which component was more applicable in their classes. Hobbs (1987) described how each PSI component can be risky when it is not properly used or monitored, and asserted:

> PSI has not brought about the educational revolution for which some had dreamed, but the push for reform and improvement in our academic institutions remains strong. Present and future users of PSI and systems employing some of PSI's features need to be aware of the risks described here as well as to their own motivation. When PSI is used, we need to ensure that it is not for all the wrong reasons. (p.107)

In conclusion, it is expected that SLI will be actively applied depending on the individual situation; however, easy experimental trial should be strictly avoided. Careful pedagogical trial is what is truly needed.

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