Knowledge
and Talent Discovery

Columbia Teacher's

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Motivations for Uses

- **Desired outcomes: improving learning**
  - **information on the Web is underutilized**
  - **current emphasis on exploiting information**
  - **need to address security and safety issues**
- **Mandated outcomes: assessment and accountability**
  - **administration (ED) focus on accountability**
  - **develop learning and teaching profiles**
  - **need to anticipate and guide**

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Key Messages

- **Data mining targets the current learning with information technology imperative:**
  - **Web-based Learning Commission**
  - **National Academy of Sciences ILIT Committee**
- **Knowledge discovery by mining the Web as a learning approach is superior to searching and surfing the Web**
- **Data mining provides diagnostic and anticipatory guidance for assessment and accountability**
- **Virtually no education research going on**

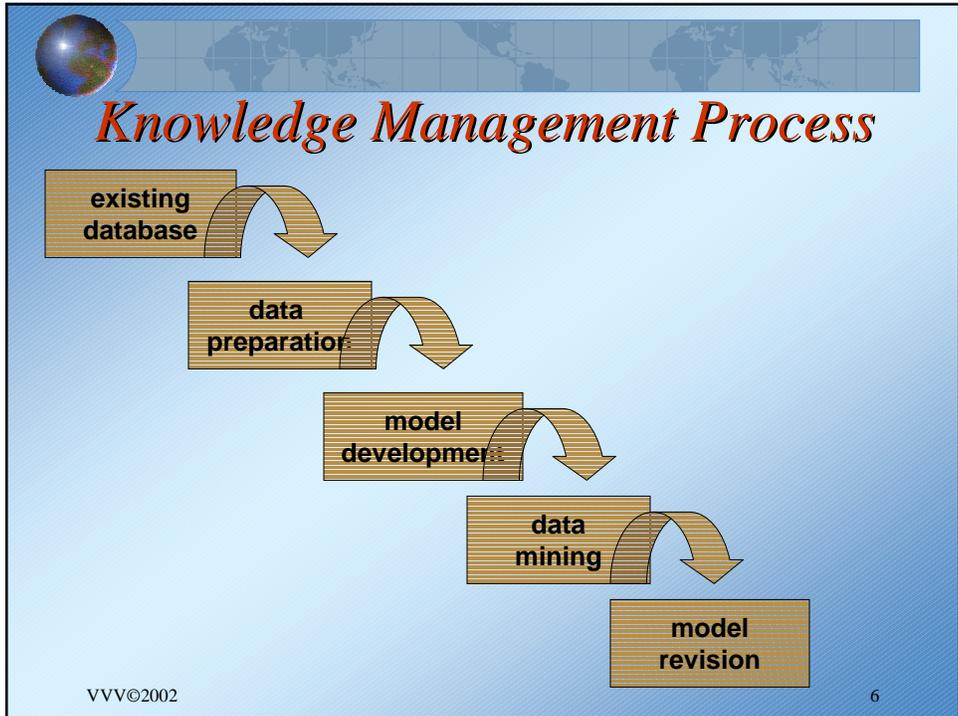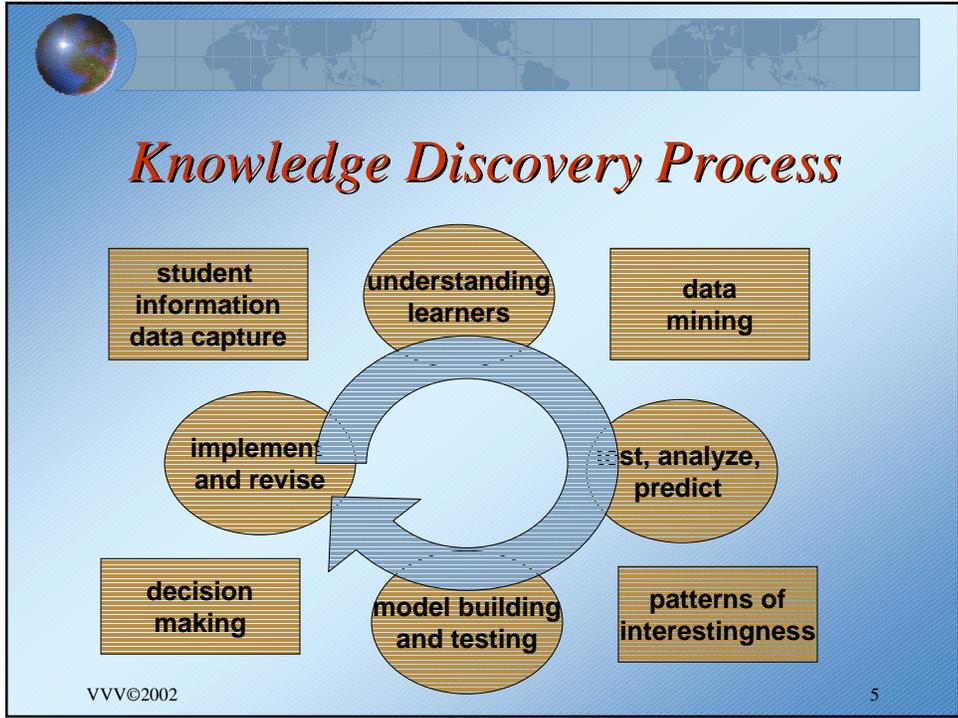VVV©2002   3

Differentiators & Product Comparison

Characteristic	Virtual Gold	Business Objects	BRIO
Lay-user	YES	NO	NO
PC-based	YES	NO	NO
Web-based	YES	NO	NO
Integration with data mining	YES	NO	NO
Requires specialist	NO	YES	YES

Patented Optimized Performance Algorithms

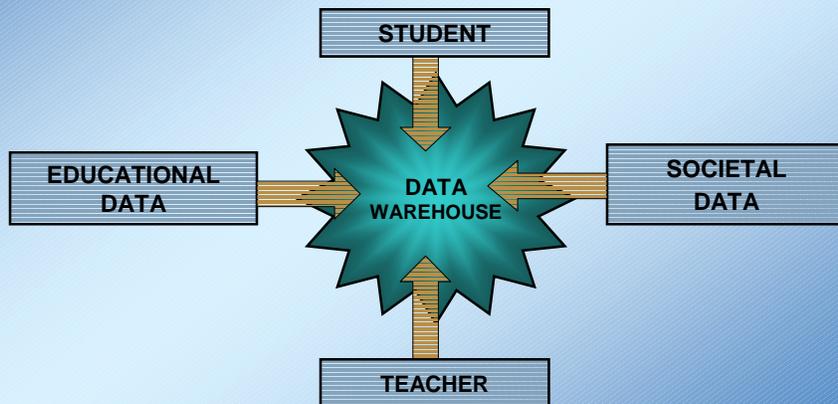VVV©2002   4

Knowledge Discovery Process

student information data capture

understanding learners

data mining

implement and revise

st, analyze, predict

decision making

model building and testing

patterns of interestingness

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Knowledge Management Process

existing database

data preparation

model development

data mining

model revision

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Domain Specific Data Collection

```
                    ┌──────────────┐
                    │   STUDENT    │
                    └──────────────┘
                           │
                           ▼
┌──────────────┐        ╱╲╱╲╱╲        ┌──────────────┐
│ EDUCATIONAL  │ ──────▶   DATA   ◀── │  SOCIETAL    │
│    DATA      │        WAREHOUSE      │    DATA      │
└──────────────┘        ╲╱╲╱╲╱        └──────────────┘
                           ▲
                           │
                    ┌──────────────┐
                    │   TEACHER    │
                    └──────────────┘
```

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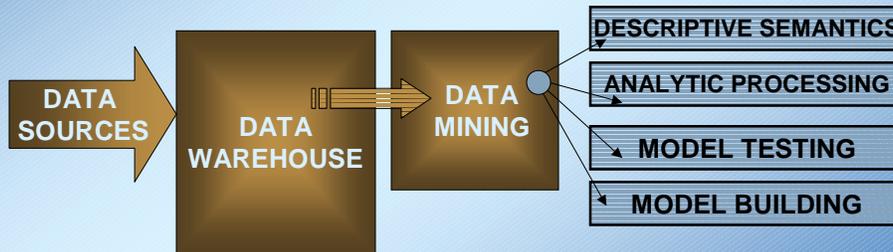

Domain Specific Data Collection

- Student:
  - Type and severity of disability, gender, academic performance, emotional status, behavioral and performance data, IEP goals and objectives, daily performance
- Teacher:
  - Degree, professional development training, number of years teaching and certification
- Educational:
  - Number of faculty and students, available software and curriculum resources, curriculum offerings and class size, student computer ratio, school day structure
- Societal:
  - Workforce setting, rural or urban setting, regional literacy rates

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Patterns, Relationships, Predictions...

```
DATA
SOURCES  →  DATA
            WAREHOUSE  →  DATA
                          MINING
```

- DESCRIPTIVE SEMANTICS
- ANALYTIC PROCESSING
- MODEL TESTING
- MODEL BUILDING

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Basic Data Mining Process

- Select problem to explore
- Select databases as source research data
- Select data items (fields) that may provide insight
  - Any data item can become an "attribute for analysis"
  - Any data item can become an "impact measure"
- Select attributes and impact measures (fields)
  - Impact measures can be Low or High Impact
- Click on "find interesting stuff" (launch mining technology)
  - Refine research with additional attributes & impact measures
  - Refine research with additional data sources
  - Reiterate the process for knowledge discovery
- Report the research results and the research process and rationale for decisions and findings

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Possible Application Areas

Mine-to-Learn

- discovery-based learning tool
- builds on existing school Web infrastructure
- exploits data on the Web, charts, reports, etc.
- any data (subject area, grade level)
- exploits other media based on query application
- mines against any relational database
- lay user, point&click, PC-based, Web-based
- requires little training, no statistical skills
- low cost, no technical support

Mine-for-Talent

- creates teaching and learning profiles
- exploits any and all available assessment data
- IEP, SAT, report cards, portfolio, projects
- builds on existing databases and data collection
- builds on existing school Web resources
- exploits other media based on query application
- mines against any relational database
- lay user, point&click, PC-based, Web-based
- ➤ requires little training, no statistical skills
- low cost, no technical support

A Diagnostic Prescriptive Program:

- **Personalized Learning**
- **Educational Challenge:**
  - ➤ Engage the learner through knowledge discovery and exploration
- **Curriculum Challenge:**
  - ➤ Understand the relationship between data patterns and criticality factors for a given subject area and topic of interest to the learner
- **Application's Basic Task:**
  - ➤ Develop educational, media and data design illustrations digital library
- **Concurrent Assessment Challenge:**
  - ➤ Study instructional, media and data characteristic
- **Formative and Summative Data Gathering:**
  - ➤ Educational process, curriculum activity, learning/teaching styles

Learning and Teaching Profiling:

- **Authentic Assessment**
- **Educational Challenge:**
  - **Create a continuous teaching and learning evaluation feedback loop**
- **Assessment Challenge:**
  - **Understand the relationship between student grades and performance, metacognition and motivation**
- **Application's Basic Task:**
  - **Apply technology to collect, analyze, interpret and communicate learning and teaching characteristic to improve instruction at the student level**
- **Formative and Summative Data Gathering:**
  - **educational process, curriculum activity, learning and teaching characteristic**

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Mine-to-Learn Example

- Project-based Task: Virtual Meteorology
  - **Target NOAA databases and local GIS data**
  - **Select data relevant to a given geography region**
  - **Data for analysis: weather patterns**
  - **Criteria for measurement: forecast for Venezuela**
  - **Exploits data on the Web, charts, reports, etc.**
  - **Project weather forecast**
  - **Compare to other regions in the same geography**
  - **Map to agricultural, industry, travel factors**
  - **Predict social trends and economic prosperity**

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Mine-for-Talent Example

- **Project-based Task: Diagnose and predict student performance and develop individual learning profiles**
  - **Targets student's report card, SAT scores, portfolio assessment data, IEP, etc.**
  - **Selects data relevant to a student's performance and potential, interests and motivation**
  - **Data for analysis: learning characteristics**
  - **Criteria for measurement: learning outcomes**
  - **Exploits other data on the Web that relates to performance evaluation, standards, etc.**
  - **Goal is to present a multidimensional assessment of the student's learning profile**
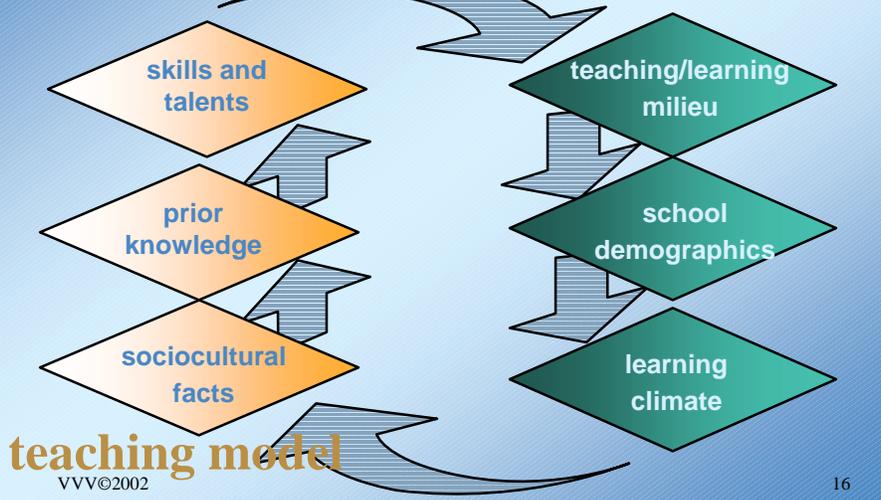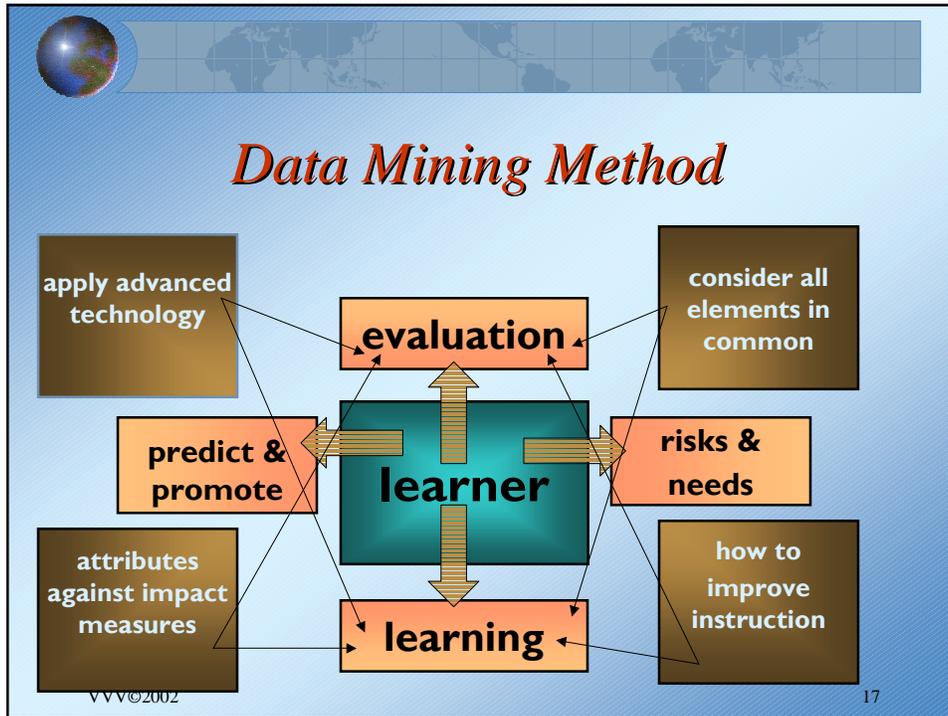 - **Helps to predict student's potential and learning needs**

Modeling Method

learning model

skills and talents

teaching/learning milieu

prior knowledge

school demographics

sociocultural facts

learning climate

teaching model

Data Mining Method

apply advanced technology	**evaluation**	**consider all elements in common**
predict & promote	**learner**	**risks & needs**
attributes against impact measures	**learning**	**how to improve instruction**

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Consulting Approach

- Academic consulting
  - higher education
  - medical schools
  - foundations
  - not-for-profit
- Government consulting
  - ED, SEA's, LEA's, DoL, DoC, Military, etc.
  - other state and local agencies
- Private industry consulting
  - media, career services, etc.

research enhancement activities

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Summary

- Data mining in education research is just beginning to emerge
- Learning application areas include all subjects and all grades
- Assessment application areas include all modes of data gathering and observations
- Research focus can be purely educational or technical or both
- Research results can lead to business opportunities

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Thank You!